Environmental Education

Compendium for Energy Resources

A Cooperative Presentation by:
The California Department of Education
The California Energy Commission
July 1998

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Acknowledgments

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California Energy Commission
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To the Educator

Dear Educator,

It is our pleasure to present the *Compendium for Energy Resources*, a cooperative project by the California Department of Education and the California Energy Commission.

We recognize that you, as educators, face an enormous challenge in integrating energy education into your classrooms. While a great deal of material exists within the realm of energy and environmental education, some may not be readily accessible or may fail to meet the high standards established by the California frameworks.

Current educational standards stress that students actively construct their own knowledge of environmental concepts and issues through research, discussion, exploration, and application. This understanding provides students with the tools with which to analyze diverse perspectives, apply their knowledge, and develop strategies for responsible action.

Materials in this compendium not only meet these standards, but are organized to help you locate up-to-date and accurate curricula which portray energy challenges and dilemmas facing California and the world in the years ahead.

This compendium is one in a series providing information on quality environmental education instruction materials. We hope the *Compendium for Energy Resources* helps you instruct and empower your students, as they participate in activities designed to explain and conserve energy resources.

Students need to understand the implications of their personal resource use and energy practices so that they can make informed decisions.

You, as educators, play a vital role in this process by incorporating energy resource instruction into your classroom.

We offer this compendium to you and to the children of California.

Sincerely,

Bill Andrews
Education Program Consultant
Science and Environmental
Education Unit
California Department
of Education

Stephen M. Rhoads
Executive Director
California Energy Commission

Table of Contents

About This Compendium

INTRODUCTION

This compendium is an easy-to-use guide to environmental education materials focusing on energy resources. Interdisciplinary by nature, environmental education is appropriate in any subject area, and many educators often integrate environmental concepts into their lesson plans. Finding suitable materials, however, can be a time-consuming and complicated task. This compendium of curriculum materials is intended to assist educators in their selection of lessons appropriate for classroom use.

CONTENT OF CURRICULA

An extensive, nationwide search was conducted to locate and obtain teaching materials that focus on energy resources. Many of the curricula focused on a specific aspect of energy, such as renewable energy or energy conservation, while others covered a wide spectrum of energy issues. Topics ranged from household electrical safety to superconductivity.

Some materials were either too narrowly focused in scope or were not true curricula. While these materials adequately covered a narrow number of topics, they did not offer enough depth on a broad range of energy resource concepts to warrant inclusion with other, more complete curriculum. These materials are listed separately in the Appendices as “Supplementary Materials.”

EVALUATIONS

On the following pages you will find both descriptive and evaluative information on each curriculum receiving an overall minimum average grade of B or higher in grades 4-12 and B- or higher in grades K-3. Evaluation scores were derived by statistical means based on the reviewer’s data. Two sample pages are featured from each curriculum. Due to the length of some lessons, only a portion of the sample lesson may have been reproduced. Each evaluation includes a description of the curricula, ordering information, a “report card,” discipline emphasis, and brief comments from the evaluators. Although the evaluator’s comments are edited for clarity, they are all gleaned from the reviewer’s written evaluations.

REVIEWERS

The curricula were evaluated by two regional teams of outstanding environmental educators from throughout California. These educators were chosen on the basis of their environmental education experience and expertise, as well as their understanding of the topic area and state education frameworks. This distinguished group of educators provide an important service to all concerned with environmental education.

MATERIALS

The curricula were evaluated using an evaluation tool developed by the California Department of Education in collaboration with other state agencies. The goal of this evaluation was to identify curricula which aligned with the evaluation criteria of instructional materials adopted by the State Board of Education and other policies framed by the State Legislature and the California Department of Education.

The curricula were evaluated for their accurate and comprehensive presentation of issues related to the topic of energy resources. Additionally, the curricula were evaluated for appropriateness at four grade-group levels: K-3, 4-6, 7-9, and 10-12. Each piece is evaluated by a team of educators who have teaching experience at the target grade-group level.

Multi-level curricula were evaluated at each level that they encompassed, resulting in some curricula being evaluated by four different evaluation teams.

For ease of use, the main body of the compendium is divided into the four grade-group sections. Curricula are arranged within each section by rating; those with the highest ratings are listed first. Some curricula may appear in more than one grade-group section.

APPENDICES

Included in the appendices are reviews of supplementary materials; a description of the Curriculum and Compendium Project coordinated by the Office of Environmental Education within the California Department of Education; the Unifying Concepts for Environmental Education; the Conceptual Matrix for Energy Resources; a correlation of the Conceptual Matrix to the California education frameworks; and the evaluation tool.

FUNDING

This project is funded through a cooperative agreement between the California Energy Commission and the California Department of Education through a State Priority grant from the Environmental Education Grant Program.

CONCLUSIONS

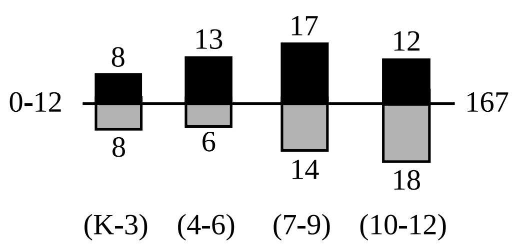
While this compendium is intended to show the strengths and weaknesses in existing curricula, it is also designed to serve as a guide for future curriculum development. The compendium identifies several outstanding curricula in the field of energy resources; however, even some of these materials would benefit from further refinement.

Three trends emerged from this curriculum review process. First, age-appropriate materials are readily available at all grade levels, increasing in difficulty and scope through the high school level. Second, while energy resources may seem a topic strictly for science classes, several curricula have successfully integrated the topic into other academic disciplines. Third, energy resources, by nature, provide a natural connection between local and global issues.

This compendium serves as a tool for educators interested in integrating the study of energy resources into their classrooms at all levels, local tox global. Such an effort will promote student connections with other people and places and ultimately empower these students to make responsible choices now and throughout their lives.

Significant Findings

The purpose of this curriculum review is to identify strengths in existing teaching materials, reveal curricular areas that need improvement, and guide future curriculum development. This analysis provides direction for revision of existing curricula and for development of future curricula within the specific topic of energy resources. Ninety-one curricula were evaluated, 50 of which scored high enough for inclusion in this compendium. Findings related to the original curricula are summarized below.



After each curriculum was evaluated it received an overall score based on the criteria contained in the evaluation tool on pages 110-113. The number of points possible was 250. This graph displays the number of materials, by grade level, scoring above or below the average score of 167.

SCORING AND INCLUSION

Materials in grade levels 4-12 with an overall average score of B and above were included in this compendium; materials scoring B- and above were included at the K-3 level. Primary materials receiving a B- were included to provide more choices for the K-3 teacher, as only three curricula at this level scored higher than a B-.

PRIMARY MATERIALS

Throughout the entire series of six topical environmental education compendia, primary education materials have scored relatively low. The energy resources curricula were no different; only half of the materials reviewed scored high enough for compendium inclusion. In general, the energy resources curricula which were chosen for inclusion in this compendium provide age-appropriate treatment and presentation of energy topics and teaching strategies.

TRENDS

A high percentage of energy resources curricula score highest in general content, lower in presentation, lowest in pedagogy, and moderately high in teacher usability. Few curricula deviate from this trend; those that do often reflect the highest overall scores. Most curricula clearly indicate grade level appropriateness for individual lessons or units. Authentic assessment devices are often lacking.

CONTENT

Specific topic areas in energy resources curricula range from geothermal or solar energy to broad overviews of energy sources and uses. Safety is stressed in the primary materials. Junior high/middle school and high school curricula often include action projects such as school energy audits. Evaluators find occasional bias either in favor of a particular energy resource or against conservation issues.

Grade Level Coverage

Fifty curricula are presented in this compendium. The highest number of materials appear in the 7-9 grade level, with seventeen curricula (thirty-four percent of the total) scoring 167 (B) or higher. Other grade levels are represented as follows: K-3 — eight curricula (sixteen percent), 4-6 — 13 curricula (twenty-six percent), and 10-12 — twelve curricula (twenty-four percent).

PEDAGOGY

Authentic assessment devices are often lacking, even in higher-scoring materials. Cooperative learning strategies are utilized in many curricula; although evaluators note that some strategies presented as “cooperative learning” did not truly use cooperative learning strategies. Several primary and intermediate curricula contain lessons which present abstract energy concepts in age-appropriate ways.

MULTILINGUAL MATERIALS

A few curricula are translated, in whole or in part, into Spanish or French. Some stories and letters to families are translated. Few curricula offer suggestions for teaching Limited English Proficiency students.

PRESENTATION

Many curricula feature home action projects and provide suggested text for take-home letters. Conflicting points of view are infrequently addressed in the evaluated curricula. Several curricula are too difficult to read due to formatting complexity, with the most frequent comment in this area being too much text on the pages. Several curricula require a significant amount of reading for both the teacher and student.

Field Guide to the Reviews

Each curricula receives an overall grade, as noted in the Report Card. This grade corresponds to the number if icons appearing here: 5 icons represent A+; 4 1/2 icons, A; 4 icons, A-; 3 1/2 icons, B+; 3 icons, B; and 2 1/2 icons, B-.

This indicates the grade level of this evaluation. Multilevel curricula are evaluated at all applicable grade levels and may appear elsewhere in the compendium.

GRADES 4-6

Title

Publisher
Address
Phone number
Grades 4-12.

Cost

Description: descriptions are based on information from the curriculum's introduction. This description may mention units or modules not specified after the title; these units or modules may appear at other grade levels or may not relate to energy issues.

Grade level: Grade levels are described as indicated in the curriculum. Each unit is listed separately. For example, if a K-6 curriculum package has separate binders for each grade, it is listed as K, 1, 2, 3, 4, 5, 6.

These grades reflect the numeric score earned by the curriculum for each evaluation area.

REPORT CARD

Overall Grade	**A**
General Content	**A**
Presentation	**A-**
Pedagogy	**A**
Teacher Usability	**A-**
Energy Content	**A**

Discipline Emphasis

Science 5
History/Social Science 4
Health 1
Mathematics 1
Performing/Fine Arts 1
Language Arts 5
Industrial/Vocational Education 0
Foreign Language 0

Evaluators indicated the degree of emphasis placed on each discipline. Results are reflected on this scale with zero (0) indicating no emphasis and six (6) indicating major emphasis.

COMMENTS

These comments reflect the evaluator's written responses on the narrative portion of the evaluation tool and are categorized by topic. If there were no comments on a particular topic, that heading will not appear.

General Content

Presentation

Pedagogy

Teacher Usability

Specific Content

Additional Teacher Thoughts
Comments in this section are of a general nature and reflect evaluators' overall opinions rather than responses to specific topic areas in the evaluation tool.

The facing page contains two sample pages from the curriculum. Many lessons are more than two pages in length; therefore, sample pages may not include an entire lesson.

Teach With Energy!

National Energy Foundation
5225 Wiley Post Way, Suite 170
Salt Lake City, Utah 84116
801-539-1406
801-539-1451 (fax)
e-mail: info@nef1.org
http://www.nef1.org

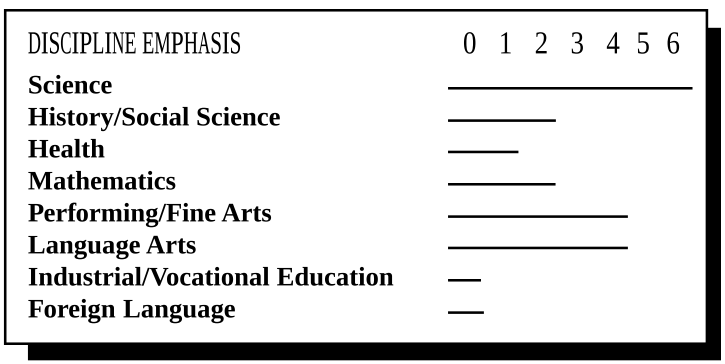
Item #11TWE: $15 per copy; 160 pages, 1990. Teachers receive a 20% discount upon request. *Teach with Energy!* is available on the web for $15.

Grades K-3

An energy, electricity and science resource guide for teachers.

REPORT CARD

Overall Grade	**B+**
General Content	**B+**
Presentation	**B**
Pedagogy	**B**
Teacher Usability	**A**
Energy Content	**B+**



COMMENTS

General Content
Student is able to gain in-depth understanding of each theme presented. Great learning objectives. Grade level appropriate activities.

Presentation
Explains energy in layman's terms. A variety of wonderful activities from coloring books to games. A very cohesive, developmentally appropriate, thorough curriculum on energy awareness.

Pedagogy
The nature of energy requires inference (i.e. the sun, coal, etc. are things students cannot touch). This curriculum does a good job of bringing the concepts to the student's level (K-3).

Teacher Usability
Excellent teacher resource section. Thorough teacher background.

Energy Content
Excellent background information for teachers and students on coal, oil, natural gas, and how these energy resources are formed.

Energy For Electricity

Activity 12

Science	Conversions	Grades K-3	Time 60 min.

Concept

There are man-made and natural energy conversion systems.

Activity Goal

The students will observe an artificial conversion system.

What You'll Need

- Tea kettle
- Hot plate
- Pinwheel
- Cooking or scientific thermometer
- Beaker or can
- Energy For Electricity Puzzle - one for each student

What To Do

1. Explain to students that one form of energy can be changed (converted) to another. For example, the energy of coal, natural gas, or oil can be converted to heat energy. Have students share what they know about steam. Name various uses for steam such as steam heat for buildings, steam engines, or the use of steam to produce electricity. Ask students what was converted to make steam.

2. Teacher Demonstration: Using a hot plate, boil water in a tea kettle. As the steam rises place a pinwheel in the path of the steam. Explain that the heat energy was used to boil the water to create steam. The force of the steam moves the pinwheel.

Discussion:

A. How long did it take the water to boil?

B. How long did it take the wheel to begin turning?

C. How long does it continue turning?

D. What happens to the heat energy produced by the hot plate?

E. Is all the steam being used to turn the wheel?

F. Ask the student where the hot plate gets its energy.

3. Tell students how heat is used to generate electricity: Coal, oil, or natural gas can be burned to produce heat energy. The heat energy is then used to turn water into steam. The steam is then used to turn a turbine (a pinwheel-like machine), which spins a generator (made of magnets and coils of wire). The generator produces electricity.

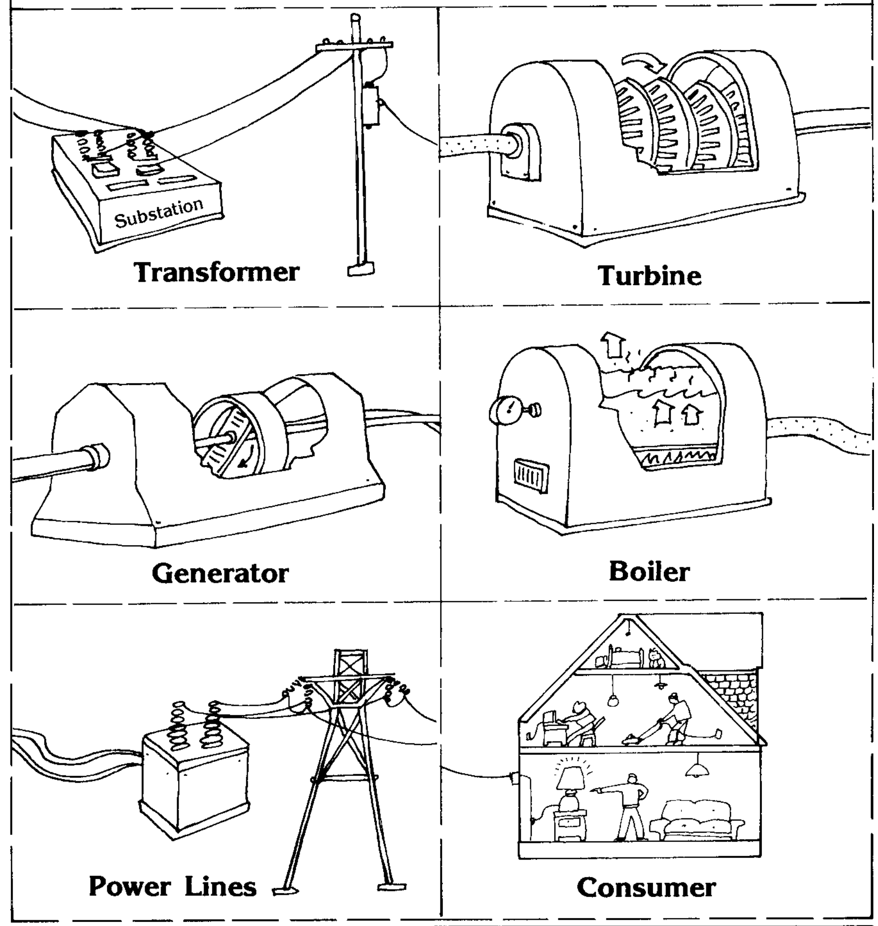
Evaluation Idea

Give students the "Energy For Electricity Puzzle." Have students cut along the dotted lines and put the pieces in order showing how a steam power plant works. The students can also color the pictures.

Energy For Electricity Puzzle

Name ______________________

Date ______________________



The Energy Sourcebook——Elementary Unit

TVA Environmental Research Center
P.O. Box 1010, CTR 2C
Muscle Shoals, AL 35662-1010
205-386-2714
205-386-2126 (fax)

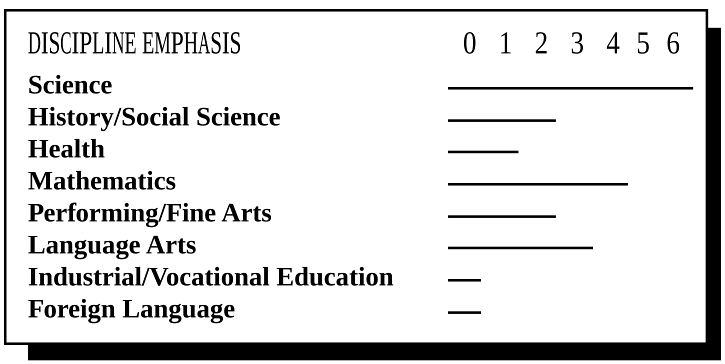
$35 each; 1992.

Grades K-3

The “Sourcebook” is intended to aid elementary teachers in teaching basic science and real-life applications of scientific principles in energy studies.

REPORT CARD

Overall Grade	**B**
General Content	**B+**
Presentation	**B-**
Pedagogy	**B-**
Teacher Usability	**B+**
Energy Content	**B-**



COMMENTS

General Content
Thorough, comprehensive. May be more appropriate for intermediate grades. Covers choices and consequences. Could easily stand alone as a physical science unit.

Presentation
Binder sections effectively organized. Written as an elementary guide, but doesn’t designate upper/primary levels.

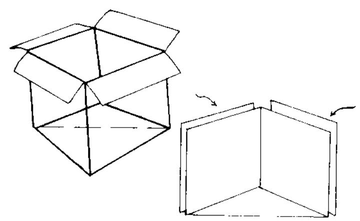
Pedagogy
Some activities are more worksheet-oriented than project or activity-oriented. Pedagogy is limited to lecture/dialogue and demonstrate/do.

Teacher Usability
Good teacher background information for all lessons. Some materials lists are quite extensive. Resources listed at the end of each lesson.

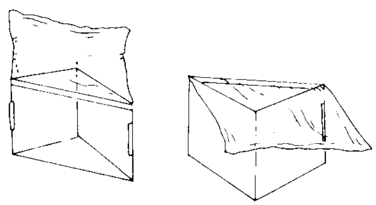
Energy Content
Good variety of lessons on energy and conservation.

HOW TO MAKE A SOLAR WATER HEATER MODEL

1. **Cut a cardboard box in half diagonally.**
   Cut the box in half along the diagonal as shown, leaving a triangularly shaped top and bottom. Then cut off the top triangle. The left-over piece has two sides that can be cut out to fit flat onto the sides of the remaining box. Then tape them to the sides of the half-box. These side pieces will add some thickness to the walls and help keep heat inside. Glue aluminum foil to the inside of the box (sides and bottom) with rubber cement (be sure to read the directions on the label).

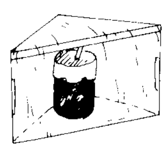


2. **Glazing the box.**
   Tape a small stick of wood (a dowel) across the top corners of the heater box as a brace. Use silver duct tape. Tape clear plastic wrap to the bottom and sides of the box as shown. Make sure it is long enough to have some left over to fold over the top. The fold-over flap can be used as a door to get into the box. You can tape heavy weights to the corners for holding it shut or you can tape the corners down.



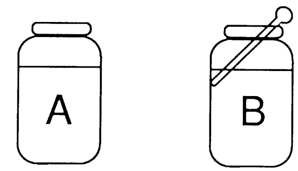
3. **Prepare the water can.**
   Use any can that is one quart in size and has no leaks. Spray paint it with flat black paint.

4. **Set up the water heater.**
   Open the top of the heater box. Fill the water can, cover the top of it with clear plastic wrap and put a rubber band around the top of the can to seal it. Place the filled can on the bottom of the heater box and close the top flap. Be sure it is well-sealed. Face the front of the box to the south and wait for it to heat up. You can test the temperature of the water by sticking a thermometer into it. You can also experiment with different colors or different kinds of cans and jars.

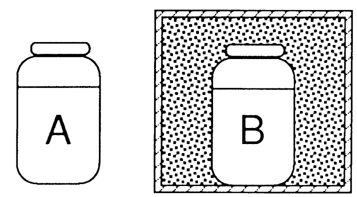


INSULATION REALLY WORKS

Fill two quart jars with hot tap water and put a thermometer in each jar to measure the temperature of the water.



Record the starting temperature on the chart below. Next, place one of the jars in a cardboard box. Cover it and surround it with shredded newspapers. The other jar remains as is.



After one of the jars is "insulated," read and record the temperature of each jar every 10 minutes. After 30 minutes have passed, compare the results.

	Jar A	Jar B
Starting temperature		
After 10 minutes		
After 20 minutes		
After 30 minutes		

Let's Get Energized!

California Energy Commission
Education Office
1516 Ninth St., MS-31
Sacramento, California 95814
916-654-4989
916-654-4420 (fax)
http://www.energy.ca.gov

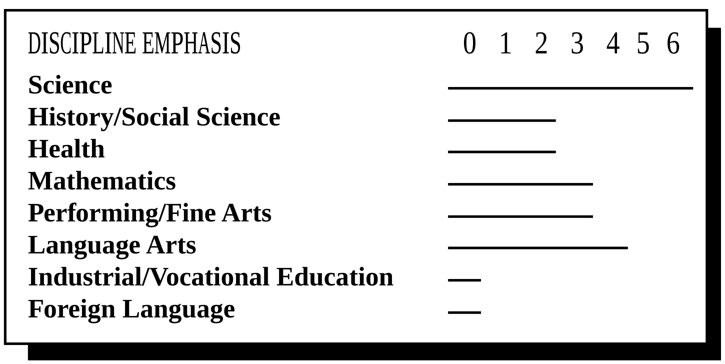
$1.50 per copy; 136 pages.

Grades K-6. Evaluation based on review of maerials for grades K-3.

A collection of energy education and awareness activities designed for after-school enrichment/childcare programs.

REPORT CARD

Overall Grade	**B**
General Content	**B**
Presentation	**B**
Pedagogy	**B**
Teacher Usability	**B+**
Energy Content	**C+**



COMMENTS

General Content
Excellent integrated lessons using a variety of instructional strategies. Interesting, grade level appropriate lessons.

Presentation
Designed as brief, fun, inclusive lessons. Few activities for Kindergarten; first grade would need a lot of revision to be age appropriate.

Pedagogy
Lacks some type of assessment plan. Uses a lot of different educational strategies. Many lessons use discovery-based learning.

Teacher Usability
Activities are designed for a multi-age, after-school program, so to use at a particular grade, the teacher needs to adapt to the specific grade. Meant as enrichment, it would not hold it's own in a classroom.

Energy Content
Great energy saver and conservation activities for latchkey or after school programs. Limited information on alternate forms of energy.

Additional Evaluator Thoughts
Does a good job for its intended audience.

Making A Solar Hot Dog Cooker

Objective: Students will make a working model solar cooker to learn that hot solar energy can be used for heating.

Preparation:
1) Gather necessary materials noted below.
2) Practice step 2 of the procedure and be familiar with how to make a parabolic curve. It is important to be as exact as possible on the curves.
3) Make a solar cooker to show students a completed model.

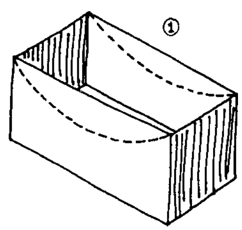
NOTE: This activity requires a fair amount of precision in measurement. If you plan to use these for making a snack be sure you have tried the building process first so that you will be able to help students build their's successfully. **This activity requires a warm (75 + degrees) clear day.**

Materials: Day 1
shoe box or similar long, narrow box made of cardboard
aluminum foil
poster board
wire (coat hangers or bailing wire work well)
glue
tape
scissors or utility knife

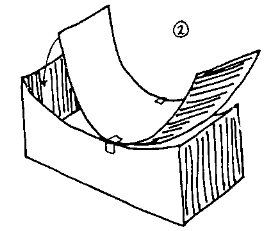
Materials: Day 2
Hot dogs
Other materials needed for snack

Time Frame: This is a 2 day activity. Allow 30 minutes the first day and 30+ minutes the second day depending on temperature and weather conditions.
Suggested Audience: grades 1 to 6

Procedure: Day 1
1) Group students into pairs (a younger student with an older partner)
2) Using a long (the longer the better), narrow box, or box made of cardboard pieces, cut a curve as shown in figure "1". It is important that the curve is symmetrical (*To make a symmetrical curve follow these steps: a) measure from end to end to find the mid-point "1a" then measure down 3 inches from the top lip of the box "2b". This is the bottom point of your curve. From this point measure in each direction and split the distance into


1

half again "3c". Measure 2 inches down and mark this point "4d". From this point to the end measure half way again "5e", and then down 1 inch "6f". Then with a sweeping curve connect these points to the top corners of the box.)
3) After tracing the curve with a pencil, cut it out on both sides with a utility knife or scissors. Stress the importance of being precise.
4) Measure and cut a piece of poster board that will fit flush against the opening of the box. Attach this with tape, beginning at the center and working toward the edges. (figure 2)
5) Cover the curve with glue and apply the foil, shiny side out. Try not to wrinkle or fold the foil; you want it to be as smooth as possible. (figure 3)
6) Use 2 scraps of cardboard, one taped to each side, as supports. (figure 4) Using the sun or a projector light, test the focal point of the cooker. There should be a bright spot on the supports where the light is concentrated. Mark this spot and punch a hole for the skewer. For skewers, use a piece of wire or a section of a coat hanger without a sharp point.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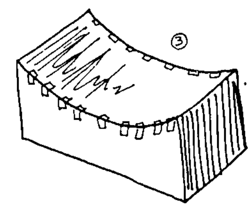
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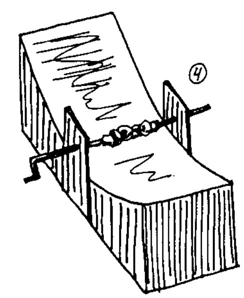
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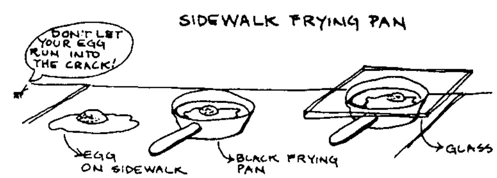
Preparation: Day 2 (Must be warm - 75 degress or more, and clear.)
1) Set up solar cookers in an area that receives full sun.
2) Cut the hot dogs in half and put on the skewer of the solar cooker
3) Remind students that their shadows will stop the cooker from working.
4) Rotate the hot dog on the skewer every few minutes to get it cooked all the way through.
5) Eat and enjoy.

BONUS IDEA FOR HOT WEATHER:

Sidewalk frying pan

Adapted from: Get Your Hands on Energy



Think Earth!

The Energy Source Education Council
Education Development Specialists
5505 E. Carson Street, Suite 250
Lakewood, CA 90713-3096
562-420-6814
562-420-1485 (fax)

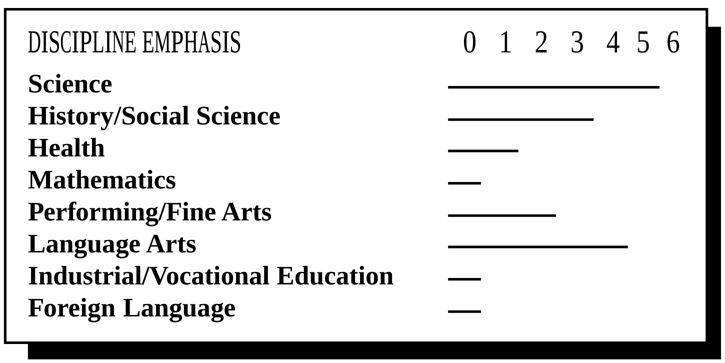
$40 per unit for Preschool, Kindergarten, Grade 1, Grade 2, Grade 3.
(Each unit includes Think Earth Video, teacher's guide, posters, story/resource cards, and blackline masters.) K-1, 1991; pre-K, 1995.

Grades PreK-1

Grade level specific, five-lesson units focusing on conserving natural resources and reducing waste and pollution.

REPORT CARD

Overall Grade	**B-**
General Content	**B+**
Presentation	**B+**
Pedagogy	**B-**
Teacher Usability	**B+**
Energy Content	**C+**



COMMENTS

General Content
Simple units that build on each other from pre-K through 6th grade. Many language arts activities.

Presentation
Developmentally on target. Good video and activity cards. Aesthetically appealing to young students and also teachers.

Pedagogy
Assessment could be improved. Good activities.

Teacher Usability
Extensive resource guide which includes addresses and phone numbers plus a nice environmental literature list. Stories and home activities are available in Spanish. Material would be friendly for new teachers (or substitutes) to use.

Energy Content
Mini units in conserving natural resources, reducing waste, and minimizing pollution.

LESSON 3: Recognizing Products From Natural Resources

Objectives:

- Unit Outcome #1—Students will understand the following environmental concepts:
  - b. The natural environment provides valuable resources that our families use to live.
  - c. Everything comes from the environment: we build houses and make paper from trees; we use plants and animals for food and clothing; we drink water and use it to clean; we burn oil, natural gas, and coal for heat, transportation, and electricity.
- Unit Outcome #2—Students will:
  - a. Identify the natural resource base of given products.

Materials:

- Natural Resource Cards
- Product Cards
- Practice Exercise 1

Advance Preparation:

- Make a copy of Practice Exercise 1 for each student (or make an overhead transparency and work through the exercise as a class).

Procedures:

A. Conduct group practice using the Natural Resource Cards and the Product Cards

- Hold up each of the Natural Resource Cards and have students identify each natural resource. As each resource is named, tape the card to an empty chair at the front of the room.
- Hold up each Product Card and ask individual students what the product is. As soon as a student names the product, ask the student to sit in the chair showing what natural resource that product is made from. If the student gets the natural resource correct, hand the student the product card and have him or her return to his or her seat.
- Work through all 16 Product Cards. To extend practice, you might want to bring in some actual products (e.g., cotton T-shirt, frying pan, apple, pencil) or have some pictures of other products cut out from magazines. *(**Note:** If you use any products made from plastic, explain to students that all kinds of plastic—food wrap, bags, bottles, toys, even some clothes—are made from oil.)*
- When the resource base for all products has been identified, ask all the students holding cards or products to stand by the chair with the natural resource card that their product is made from. Have any students without cards or products check to see if everyone is standing by the right natural resource.

B. Identify classroom resource bases

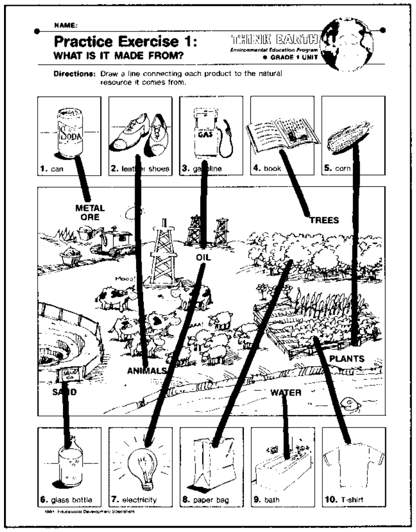
- Ask a student to point to and name any object in the classroom. Ask other students what natural resource or resources were used to make that item.
- Ask other students to point to and name other objects in the classroom and tell the natural resource base. Continue until most everything in the classroom has been named.
- Help students see that **everything** we have comes from the environment.

C. Have students complete Practice Exercise 1, *What Is It Made From?*

- Give each child a copy of Practice Exercise 1, *What Is It Made From?*
- Read the directions aloud to students. Then explain that the big picture in the center shows natural resources, and the little pictures are products. Have students identify each natural resource in the big picture.
- Work through the exercise one item at a time. For each picture, read the name of the product and ask students what natural resource it is made from. Have students draw a line connecting the product picture to the picture of the natural resource from which it is made.
- Circulate among the students, making sure that they draw the lines **correctly**.

D. Conduct additional activities

- **Cut and paste products on natural resources.** Provide groups of students with poster boards titled with each natural resource. Each group could have all the natural resources or just a few, or each group could have one different natural resource. Give each group several old magazines and have students cut out pictures of products and paste them on the board showing what natural resource they were made from. Have each group share their collages with the class.
- **Make a resources/products bulletin board.** Have students start a bulletin board of products organized by natural resource base. Students can look through old magazines for pictures.
- **Play "Who am I?" with product cards.** Have a student pick a product card and play "Who am I?" Allow the other students to ask 3 Yes/No questions to determine which product was selected, e.g., "Are you made from paper?" "Are you worn as clothing?" etc.



- **Play Product/Resource Game.** Have a few students play a game with the product cards. Put the cards in a stack with the pictures face up. Have each student, one at a time, name the product on top of the stack and tell what natural resource it is made from. If the student is correct, he or she keeps the card. If not, the card is returned to the bottom of the stack. The student with the most cards after all cards have been drawn wins the game.
- **Learn a song.** Teach students the following song about not littering.

  (to the tune of "Frére Jacques")

  Do not litter. Do not litter.
  That's a rule. That's a rule.
  Put all your trash in trash cans.
  Put all your trash in trash cans.
  Thanks a lot. Thanks a lot.

Offalot

The Energy Source Education Council
Program Distribution Office
5505 E. Carson Street, Suite 250
Lakewood, CA 90713-3096
562-420-6814
562-420-1485 (fax)

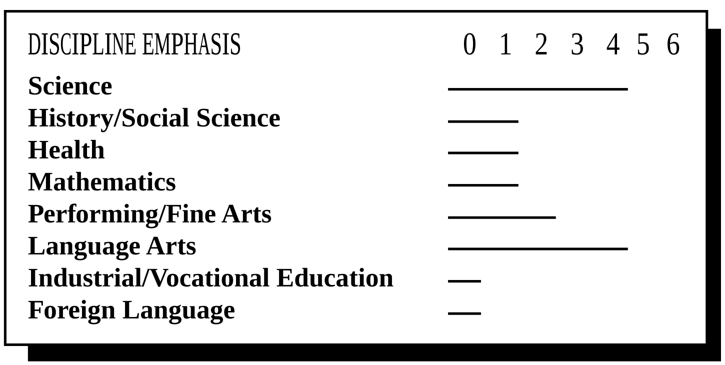
Class set $65 (includes 36pg. teacher's manual and 35 student copies); audiocassette, puppet, and other support materials available; 1990.

Kindergarten

Introduces children to the use of energy in the home and helps them develop an awareness of important conservation and safety practices.

REPORT CARD

Overall Grade	**B-**
General Content	**B**
Presentation	**B**
Pedagogy	**C+**
Teacher Usability	**B+**
Energy Content	**C+**



COMMENTS

General Content
Delivers information through teacher. Just a two-week unit—not core curriculum.

Presentation
Developmentally on target for Kindergartners. Much could be adapted to LEP students as well. Easily understood. Use of puppet is powerful. Very creative two week unit.

Pedagogy
Uses stories and songs to teach concepts. Not activity based. Weak assessment tool.

Teacher Usability
Lots of consumables. Colorful worksheets, puppet, and picture cards would hold a young child's interest. Good teacher background. Student booklet would have to be purchased every year.

Energy Content
Only focuses on energy consumption and conservation, not where it comes from, how we get it, or why we should conserve it. Promotes awareness of conservation and safety.

LESSON 3: Practice on Energy Users

Materials:

- Energy user picture cards
- Pupil booklets, pages 3 and 4

Procedures:

A. Use energy user picture cards to review energy users

- Conduct additional practice on identifying energy users with energy user picture cards. You can follow the same procedures as in Lesson 2, Procedure B, or you can use one of the procedures suggested below:

  — Display the energy user picture cards on the chalkboard or a bulletin board. Describe a function of a particular energy user, e.g., "This energy user washes our clothes." Then call on a pupil to come up and point out the card for that energy user. Repeat until all cards have been described and identified.

  — Display the energy user picture cards face down on a table or on the floor in front of the class. Choose a pupil to come up and select a card. The pupil must then name the energy user and tell what it does. As each card is selected, it is put in a separate pile. Repeat until all the cards have been selected and identified.

B. Have pupils complete Exercise 1, "Energy Users"

- Give each child a pencil or crayon and his or her pupil booklet. Tell the pupils to open their booklets to pages 4 and 5, the blue numbers. Explain that for each row, you will tell what a certain energy user does, and pupils will circle the energy user that does that job. Be sure pupils understand that it is all right if they do not know some of the answers. The exercise will help them learn.
- Work through the exercise, one item (row) at a time. For each item, read the instructions and give the pupils time to identify and circle the energy user being described. Then call on a pupil to name the correct energy user. Any pupil with an incorrect answer should erase the answer or put an "X" through it and then circle the correct answer.

Exercise 1 - Instructions and Answer Key

1.

Put your finger on row 1--the star row. Draw a circle around the energy user that mixes our food.

2.

Put your finger on row 2--the cat row. Draw a circle around the energy user that washes our clothes.

3.

Put your finger on row 3--the fish row. Draw a circle around the energy user that cooks our food.

4.

Put your finger on row 4--the clown row. Draw a circle around the energy user that cleans our rugs.

5.

Turn your paper over. Put your finger on row 5--the hat row. Draw a circle around the energy user that heats our homes.

6.

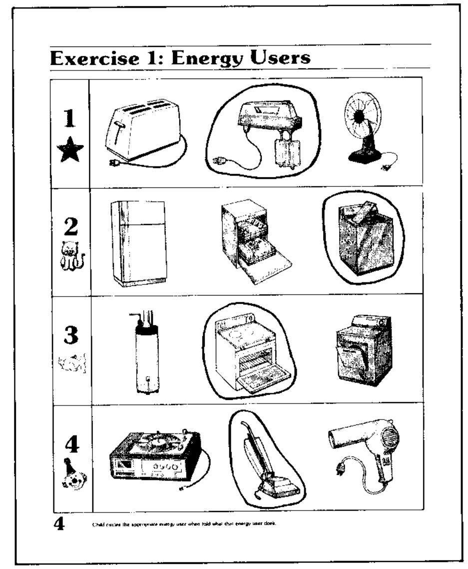
Put your finger on row 6--the dog row. Draw a circle around the energy user that sews our clothes.

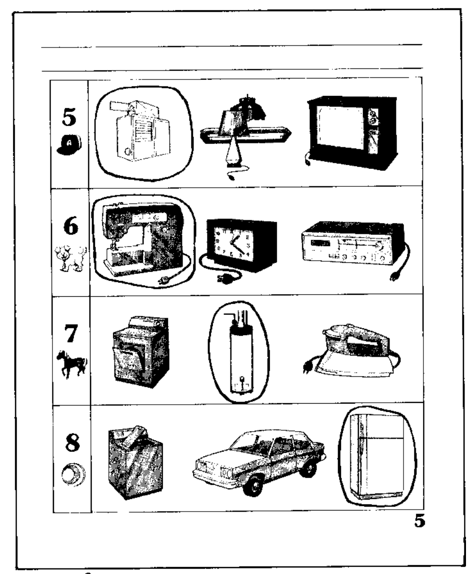
7.

Put your finger on row 7--the horse row. Draw a circle around the energy user that heats our water.

8.

Put your finger on row 8--the ball row. Draw a circle around the energy user that keeps our food cold.





Living Lightly in the City Volume I

Schlitz Audubon Center
1111 East Brown Deer Road
Milwaukee, WI 53217
414-352-2880
414-352-6091 (fax)

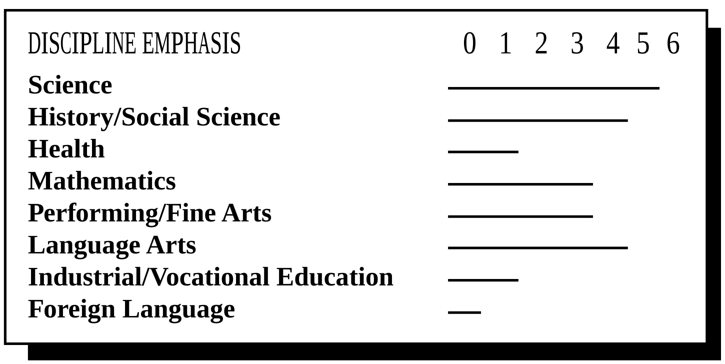
$24.00 per volume (plus shipping and handling); 178 pages, 1990.

Grades K-3

Activities designed to increase an awareness about communities; sources of water, food, energy and resources students consume daily.

REPORT CARD

Overall Grade	**B-**
General Content	**B**
Presentation	**B-**
Pedagogy	**C+**
Teacher Usability	**B**
Energy Content	**C**



COMMENTS

General Content
Varied activities which may be adapted to urban situations. Well-presented lessons with clear objectives. Thin coverage of subject matter.

Presentation
Very developmentally appropriate; deals with materials at childrens' level. Expands beyond energy awareness. Directions for lessons not concise.

Pedagogy
Open-ended questions. Needs more hands-on activities. Needs updated pedagogy.

Teacher Usability
These activities will infuse environmental concepts into an existing curriculum. Limited teacher and student background. Great teacher resources at the end of each chapter/theme. Few materials are needed; however, a lot of photocopying would need to be done.

Additional Evaluator Thoughts
Explicitly states that the K-3 guide has an "emphasis on enjoyment and development of a positive image of self and surroundings."

ENERGY ALL AROUND ME K-1

OBJECTIVE: Students will draw pictures of objects they observed being moved, lighted, or heated by energy.

MATERIALS: Energy in My House Take Me Home sheet provided; paper and crayons needed.

TIME: Two 40-minute sessions

Session 1: Take your class on a sensory energy hunt around your school. Review the senses and begin in the school building. Do children feel energy being used (heating or cooling)? Do they smell energy (food cooking in the cafeteria)? Do they hear energy being used (typewriters, people moving, bells ringing)? How many different ways do they see energy being used? Bring along a notebook and record children's observations.

Session 2: Then explore the outdoor environment with your students. Feel the sunshine and the wind and encourage children to tune in to the smells, sounds, and sights around them to observe energy in action. Count the number of things they see moving and distinguish energy in motion from objects being heated or lighted.

When you return to the classroom, review children's observations. Classify their observations according to whether things were being moved, heated or lighted. Have each child draw a picture of some of the energy in action they observed on their sensory energy hunt. Distribute the Take Me Home sheets to your students and encourage them to go on an energy hunt at home as well.

HEATING, LIGHTING & MOVING! 2-3

OBJECTIVE: Students will: 1) Observe energy being used and write sentences using action words to describe energy heating, lighting, and moving things; 2) Use graphing skills to determine how energy is used in their homes and in the outdoor environment around the school.

MATERIALS: Student Energy Hunt and Energy in My House Take Me Home sheets provided.

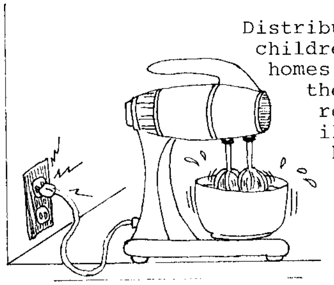
TIME: 45 minutes

Copy the Energy Hunt activity sheets and distribute one to each child. Save the Take Me Home sheet for distribution at the end of the day.

Review the definition of energy as the power to do work. Ask your students to brainstorm a list of some objects that use energy. Write their responses on the board. Then ask them to think of a way to categorize their responses. Help them to see that energy heats, lights, and moves objects. Place an H, L, or M next to each item to indicate if it is heated, lighted, or moved by energy.

Divide the students into energy-seeking teams. Then take them out on the school grounds and challenge them to see which group can find the most examples of energy in action. After ten or fifteen minutes, call the groups back together and compare notes. If they had limited success on their first trial, give them some hints for using all of their senses. They might add to their list by noticing the sun heating the earth and providing light for plants to grow. Encourage them to feel the wind and observe it moving things around them. Ask if they can smell energy being used. Can they smell food cooking or fuels burning? Look toward the school and other buildings in the area; can they see lights being used?

When you return to the classroom, tally their results. Make a bar graph to show the number of things children observed being heated, lighted, and moved. Have children write their energy action sentences and share them with their classmates.



Distribute the Take Me Home sheets and ask children to go on an energy hunt in their homes. Request that they return their sheets the following day. Then tally their results and make a class bar graph to illustrate the way energy is used in their homes. Compare this graph to the results of the outdoor hunt. Notice the differences and promote a class discussion.

Conserve and Renew

California Energy Commission
Education Information
1516 Ninth Street, MS 29
Sacramento, Ca 95814
916-654-4989
916-654-4420 (fax)
http://www.energy.ca.gov/education

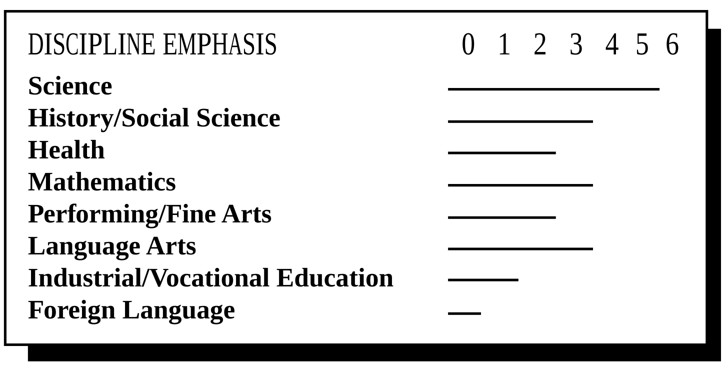
$1.50 per copy; 157 pages, 1990.

Grades 4-6

A collection of energy activities written and organized for use either as a unit on energy or as individual activities to complement existing curricula.

REPORT CARD

Overall Grade	**A-**
General Content	**A-**
Presentation	**A-**
Pedagogy	**A-**
Teacher Usability	**A-**
Energy Content	**A-**



COMMENTS

General Content
Curriculum is integrated across all disciplines. Lots of interdisciplinary activities on a wide range of energy issues.

Presentation
Provides a section on ethics. Material is clearly written with the objectives defined.

Pedagogy
The materials encourage problem solving and critical thinking. Needs more hands-on activities that are experiment based rather than game based or listings of energy uses.

Teacher Usability
The materials can be used as a unit or as individual activities to enhance existing curricula. There is little or no background for the teacher and the phrase "it gets tricky" often appears.

Energy Content
Many good lessons which identify renewable/non renewable energy sources. This is an excellent curriculum on energy conservation.

SCHOOL ENERGY MAP

OBJECTIVES: Students will become aware of the energy users at school.

SUMMARY: A map of the school will be made, and the energy users on campus charted and discussed.

GROUPING. 4-6 students.

TIME: 50 min.

SUBJECTS: Math, geography, social studies, science, language arts.

VOCABULARY: Scale, conserve, deferred, utility, budget.

MATERIALS:
- ❑ Energy Users Worksheet
- ❑ *Tape measures*
- ❑ Graph paper

PREPARATION & BACKGROUND: According to the California Energy Extension Service, typical schools spend the bulk of their energy dollars on lighting (28%), heating (25%) and cooling (13%). Other energy uses are; air handling (15%), hot water (5%), and "other" (14%). Students and staff can have a huge impact on these costs. We often use energy without realizing it. We tend to take lights and copy machines for granted. In this exercise, the students will look carefully at the energy users in their school, and learn about how the school's energy budget is spent.

You will need to find out what the utility rates are, and how much the school spends on energy. This information is all in the school utility bills; the administration should be able to provide a copy for you. Use a bill for the same month from last year. Take the total bill (gas + electrical) and the percentages given above, and determine what your school spends on energy in the different categories. (For example: Lighting % x total utility bill = approximate amount spent on lighting for one month; repeat for heating, cooling, etc.)

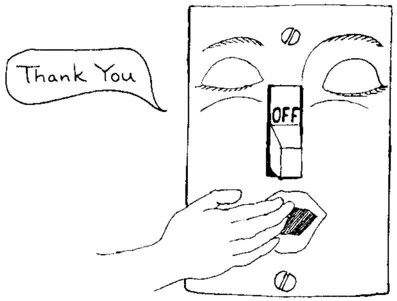
When students do the mapping, it is instructive to have access to water heaters, space heaters and cafeterias. You could pre-arrange with the custodian to help out, to open doors and accompany students in areas with large machinery. This activity can be expanded to the school district or contracted to individual wings or classrooms. To shorten and simplify the activity, you can make up blank school maps to be filled in. Otherwise it might be instructive to use graph paper, and discuss drawing to scale. Simple sketches of the school will do also. Choose the option best for your class, YOU are the expert in that department!

PROCEDURE:

1. Divide students into groups of 4-6. If you have ready-made maps, the smaller group is more appropriate. Tasks can be divided among the students. One student can translate input from others and draw the map, another can record energy users, while two students scan the area and report the things they find that are using energy.
2. Assign a portion of the school to each group. If each group works in the same scale an entire map of the school can be assembled.
3. Students will then tour the school with the worksheet that follows. They are to carefully make note of every energy user they can find, noting where they found each. (e.g. lights, refrigerators, heaters, copy machines, etc.)
4. When the maps are done, have students list all the energy users in their area. Encourage the students to be thorough. Rather than list "lights" have them be specific (e.g. 10 fluorescent lights, and 2 regular, incandescent lights).
5. Have the class reassemble and report on what they found.
6. Next, brainstorm with students how the school might save energy. You can list the ideas on the board as they volunteer thoughts like: close doors to keep heat in or out; turn off the lights next to the windows on bright days; weatherstrip the windows and doors; turn off lights during recess and after school; and reset thermostat to 68/80.
7. Distribute the worksheets and have students fill in what type of energy is being used and propose alternatives where possible. Doing the two previous activities will help students know how to complete the worksheet.

FOR DISCUSSION: 1. Do you think other people in the school realize how much energy they use?
2. Most homes use more energy for heating and cooling; schools typically use more for lighting. Why do you think there is a difference? (Hint: Lots of bodies in a classroom help keep the room warm.)
3. How can individual students help save energy at school? At home?

EXTENSIONS: 1. Repeat the exercise, only have students do their own homes this time.
2. Have students write an essay about what they think the money saved should be spent on.
3. Students could prepare a pamphlet on simple ways to save energy at school and distribute it to all classes.
4. Make posters on how to save energy at school and post them around campus.



A Child's Place in the Environment, Unit Six: Achieving a Sustainable Community

California Department of Education
Bureau of Publications, Sales Unit
P.O. Box 271
Sacramento, CA 95812-0271
916-445-1260/1-800-995-4099
916-323-0823 (fax)

Item #1278: $65 per copy (plus tax if in CA), $4.95 shipping; 538 pages, 1996.

Grade 6

A literature based science curriculum designed around four major themes: valuing the environment, systems and interactions, patterns of change, and conservation.

REPORT CARD

Overall Grade	**A-**
General Content	**A-**
Presentation	**A-**
Pedagogy	**A-**
Teacher Usability	**A-**
Energy Content	**B**

DISCIPLINE EMPHASIS 0 1 2 3 4 5 6

Science
History/Social Science
Health
Mathematics
Performing/Fine Arts
Language Arts
Industrial/Vocational Education
Foreign Language

COMMENTS

General Content
Extensive grade-level materials dealing with major ecological principles. Focuses on sustainability. Curriculum is interdisciplinary with clearly defined objectives.

Presentation
This is a well organized and designed document. It follows a traditional curriculum format.

Pedagogy
Contains curriculum-embedded assessment and utilizes a constructivist approach. Promotes critical thinking skills and problem solving.

Teacher Usability
The Teacher's Preparation section in the front seems particularly useful and sets a stage for the rest of the curriculum. Each lesson has an extensive list of resources which is annotated. The volume of material may be overwhelming —probably best introduced through teacher preparatory workshops.

Energy Content
Curriculum is focused more on human communities than on energy resources.

Lesson 3

What Are Some Components of an Ecosystem?

Story Link: In this lesson students will identify some components of an ecosystem.

Subconcept: Healthy ecosystems are biologically diverse, have complex interrelationships, and are sustainable.

Lesson's Concepts:

- All living things have basic requirements of nutrition, growth, and reproduction, needing food, water, and gas exchange for respiration. (*Science Framework*, page 116)
- Living things live in particular environments which provide them with the resources and the conditions essential for their survival. (*Science Framework*, page 136)
- An ecosystem consists of an environment in which living things interact with each other and with the physical environment. (*Science Framework*, page 137)
- The components of an ecosystem are (*Science Framework*, pages 136–139):
  - An ongoing source of energy—sunlight
  - Living things, including plants, animals, fungi, and microorganisms
  - Nonliving things, such as water, air, and land
  - Soil (in terrestrial ecosystems) (Soil is partly living and partly nonliving.)
  - Natural processes, such as energy flow and cycles (e.g., life cycles, water and carbon cycles)
- Ecosystems can be small or large, terrestrial or aquatic. Examples of terrestrial ecosystems are grasslands, chaparral, forests, and deserts. Examples of aquatic ecosystems are ponds, creeks, estuaries, and oceans.

GRADES 4-6

Overview: Students identify the needs of living things. Each cooperative group designs and prepares a habitat in a two-liter bottle for a specific organism. Students identify some components of an ecosystem on a transparency of a grassland; list the components of the Sierra Nevada ecosystem described in the book, *Sierra*, by Diane Siebert; and categorize the components. Cooperative groups design trioramas of the ecosystem they were assigned in Lesson 2. The class designs a mural of a local ecosystem and prepares a mini-ecosystem, using plastic bottles, which will also be used in Lesson 6.

Time: Two to three hours, plus time throughout several days for students to work on and present their trioramas

Vocabulary: ecosystem, energy source, habitat, organism, soil, sustainable

Curricular Connections: Science, English–Language Arts, Visual and Performing Arts

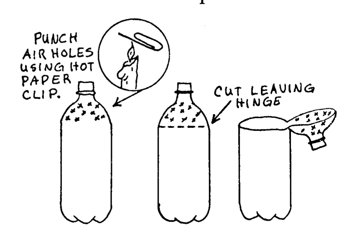
Scientific Thinking Processes: observing, communicating, comparing, categorizing, relating

Preparation

___ **1.** Make a transparency of "A Grassland Ecosystem" (page 84).

___ **2.** Prepare a habitat bottle for each group, using a two-liter plastic bottle.

- Remove the label from each bottle by soaking it in very warm water. A hair dryer can also be used to heat and soften the glue to make the label easier to remove.
- Cut the top, as illustrated. To cut, draw cutting lines around each bottle, make incisions with a knife, and cut with scissors. Leave a section connected to the bottle to act as a hinge.
- Using a jumbo paper clip heated in a candle's flame, poke air holes in the top for ventilation.



Habitat Bottle

___ **3.** Prepare an ecosystem tube (to be used in Lesson 6), using five two-liter plastic bottles, by cutting and

The Energy Sourcebook—Elementary Unit

TVA Environmental Research Center
P.O. Box 1010, CTR 2C
Muscle Shoals, AL 35662-1010
205-386-2714
205-386-2126 (fax)

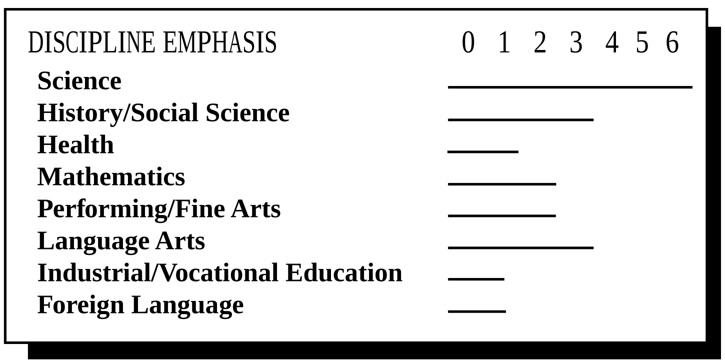
$35 each; 1992.

Grades 4-6

The "Sourcebook" is intended to aid elementary teachers in teaching basic science and real-life applications of scientific principles in energy studies.

REPORT CARD

Overall Grade	**A-**
General Content	**A-**
Presentation	**B+**
Pedagogy	**B+**
Teacher Usability	**A**
Energy Content	**A-**



COMMENTS

General Content
A wide variety of activities. The lessons seem to build on previously established concepts. The curriculum is a bit lengthy.

Presentation
The explanations for the teachers are clearly written and the lessons, while teacher directed, are logically framed. The illustrations for concepts, such as how electricity gets from a power plant to a house, are especially well done, as they are simple and clear.

Pedagogy
Each section provides at least one hands-on activity, one activity of researching literature, and one societal/historical activity.

Teacher Usability
Times to complete the lessons vary a great deal which may present scheduling problems. Good background for all lessons—quite thorough.

Energy Content
Good, solid activities in a range of energy areas.

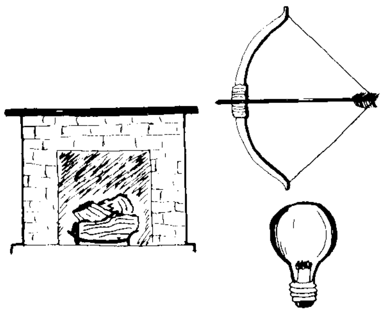
Student

THE INVISIBLE FORCE

1. What is energy? ______________________________

____

2. Draw a line from the object to the word that tells how energy changes it.

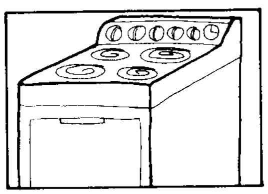


light

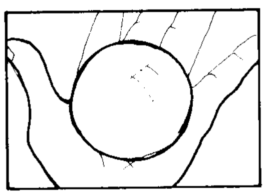
movement

heat

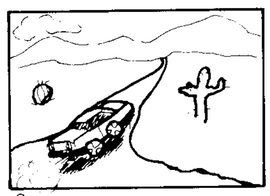
3. Label the pictures with the terms potential or kinetic energy.



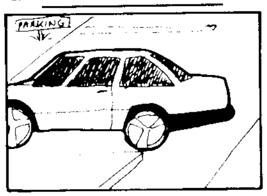
a. ____________



b. ____________



c. ____________



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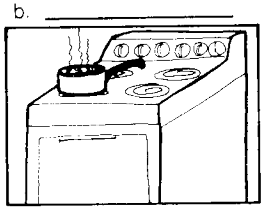

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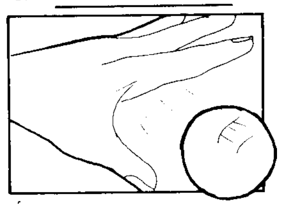


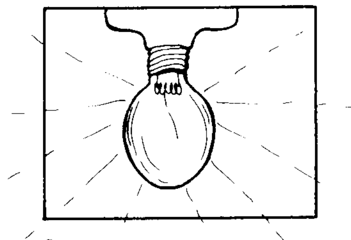
f. ____________

Student

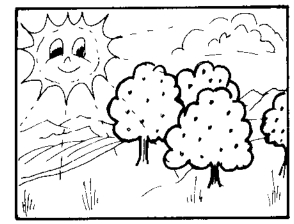
THE INVISIBLE FORCE
(continued)

4. Write the form of energy shown in each picture. Use the following terms:

solar chemical electrical nuclear mechanical



a. ____________



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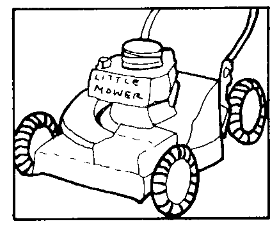
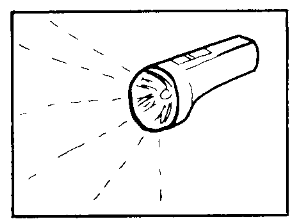
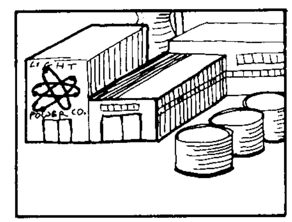


c. ____________

d. ____________





e. ____________

Energizing Your Future With Energy, Economics and the Environment

National 4-H Council
National 4-H Supply Service
c/o Cresstar Bank
P.O. Box 79126
Baltimore, MD 21279-0126
301-961-2934
301-961-2937 (fax)

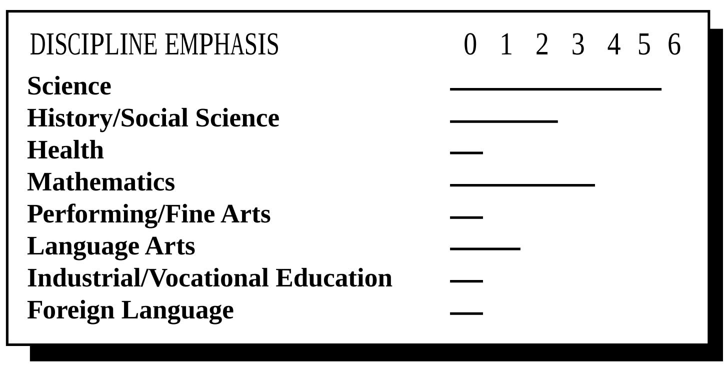
Item #ES1009: $5 per copy. 1996

Grades K-12. Evaluation based on review of materials for grades 4-6.

This guide contains five chapters, each focusing on a different topic related to the interactions among energy, economics, and the environment.

REPORT CARD

Overall Grade	**B+**
General Content	**B+**
Presentation	**B**
Pedagogy	**B+**
Teacher Usability	**B**
Energy Content	**B+**



COMMENTS

General Content
A very comprehensive curriculum with a variety of lessons emphasizing hands-on and community action activities.

Presentation
Some of the student materials are not clearly described and may be too complex for the suggested grade level.

Pedagogy
Many of the student activity pages look like ordinary worksheets, although on careful examination they present interesting viewpoints.

Teacher Usability
Provides a matrix of activities and appropriate age levels. No table of contents. While this is written for 4-H usage, many of the lessons could be easily used by classroom teachers.

Energy Content
Great material to explore world energy consumption, production, and environmental problems and economics.

Additional Evaluator Thoughts
The material helps students understand that everything costs something and there are tradeoffs in everyday life.

Activity 3.2
Auctioning Energy

Activity Goals
To demonstrate how natural resources such as energy are subject to the laws of supply and demand.

Preview
Participants play a game illustrating how supply and demand affect energy prices.

Ages: 9 to 18
Style: adult or teen led
Life Skills: disagreeing and refusing, expressing an opinion, observing and listening, asking questions to get information, comparing and selecting alternatives, managing resources to achieve a goal
Pre-Activities: 1.1, 2.1, 2.2, 2.3, 2.4, 2.5, 3.1
Time Needed: 30 minutes
Group Size: any
Indoors or Outdoors: either
Materials Needed: copies of Activity Sheet 3.2A cut apart; different types of wrapped candies

How to Do the Activity
Explain that prices help people decide what to buy, what to make, and what to sell. But how do you think prices are set? (Ask participants to give ideas.)

Prices are influenced by the *law of supply and demand*. As the price of bicycles goes down, more people want to buy them. But as the prices go down, fewer people want to sell them. So the prices may rise because the supply is influenced. As the price of bicycles go up, more people want to make and sell them, but fewer people want to buy them. In the American marketplace, the demand and supply match up fairly closely.

To demonstrate supply and demand, play the following game with the group. Give one participant a handful of candies representing a supply of an energy source (coal, oil, wood, etc.). This person will be the "Energy Auctioneer." In this situation, there is a limited supply of energy (one handful) for the entire group.

Give each person in the rest of the group 10 "dollars" from Activity Sheet 3.2A. Have the Energy Auctioneer ask people to place bids for the handful of candies. Start the bidding with one dollar. Caution participants that they will be bidding on several rounds of candies, so they probably don't want to spend all their money right away. Each round of candies may be different.

Talk about what is happening as the auction continues. Notice that as the price increases, fewer and fewer people bid (i.e., price increases, demand decreases). At some point the price gets so high that most people don't feel it's worth buying the product. Give the handful of candies to the highest bidder.

As a real-life example, note that in the 1970s the supply of oil in the United States (and other countries) was restricted by oil-producing nations. This caused prices to rise. Eventually prices got so high that people began to find ways to use less oil (lower the demand). They purchased more gas-efficient cars and conserved energy in their homes.

In the next round of the game, something new happens. Other people want to make money too, so

they decide to start selling candies. Give four people each a handful of candies different from each other. Now each of these four is an Energy Auctioneer. The supply of energy resources is much larger now.

Start the bidding process again at one dollar. Have all four Energy Auctioneers try to "sell" their energy resources at the same time. What happens? As the supply increases (assuming demand is the same), prices fall.

Ask the group: Suppose only one Energy Auctioneer can sell energy resources. What would happen? (The price would rise. This is called a monopoly. The U.S. government regulates industries to discourage monopolies.) What if another energy source (for example, solar) became available? (It depends on the price of the solar energy--if it is less than the prices of existing sources of energy, people would buy it.) What would happen to the demand for the first energy source? (It would generally go down. However, it might stay stable or even increase, if more industries and businesses were started as a result of lower energy prices.)

Share the following illustration with participants by redrawing it on a chalkboard or flip chart. This will help summarize the basics of energy economics.

Illustration CC

Evaluating Progress
Explain how the laws of supply and demand would affect the price of a favorite product (football, CD, perfume). What would happen to the price if demand increased? (Generally, it would go up.) Decreased? (Generally, it would go down.) What would happen to the price if supply increased? (Generally, it would go down.) Decreased? (Generally, it would go up.)

Fair Game
Research and report on a time in history and how energy sources were affected by supply and demand (e.g., the energy crisis of the 1970s). Show how supply and demand affected energy prices and the effect that had on people's lives.

All for One and One for All
Help residents in your community who have difficulty paying for energy by offering to weather strip their homes or provide other energy saving work. Your local utilities might have similar programs already in place that you can volunteer for. Be sure to evaluate as best you can whether your action saves energy. Ask yourself: if we replace the light bulbs in a den with low wattage ones, will people just use more lamps to do the same jobs? If we help people block drafts at the bottoms of their doors, are we using materials that provide a good return, since it took energy to make the products in the first place? Think about it, and help educate people about using energy and other resources wisely.

The California State Environmental Education Guide

Alameda County Office of Education
Media Sales
313 W. Winton Ave
Hayward, CA 94544-1198
510-670-4166
510-670-4161 (fax)

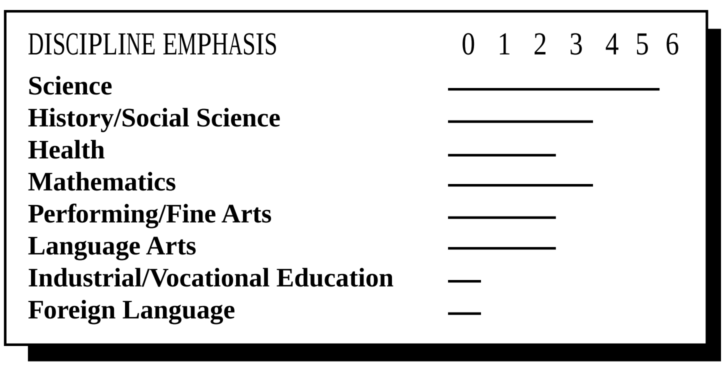
$27.01 (includes tax); 323 pages, 1988.

Grades K-6

This guide provides educators with lessons and instructional techniques that build a fundamental understanding of the environment.

REPORT CARD

Overall Grade	**B+**
General Content	**B+**
Presentation	**B**
Pedagogy	**B+**
Teacher Usability	**A**
Energy Content	**B-**



COMMENTS

General Content
Lessons are not well connected.

Presentation
These materials have a good format for presenting information to both the student and the teacher.

Pedagogy
Great lesson plans involving the students in a variety of hands-on, minds-on activities.

Teacher Usability
The index is arranged in a manner that makes it easy to find lessons supporting existing curriculum.

Energy Content
Only one lesson is given for each energy concept and they are definitely geared to looking at big ideas.

ARE YOU USING ENERGY?

SUMMARY OF ACTIVITY

Students run to see what effects using energy has on their own bodies, search out other ways to determine when energy is being used, and explain in writing how they can tell whether energy is being used.

Time: One 30- to 45-minute period

Setting: Classroom, outdoors

Materials:
- Butcher paper
- Marking pens
- Writing paper

Subjects: Science, physical education, language arts

Key Words: Energy, heat, light, motion

CALIFORNIA FRAMEWORK CONNECTIONS

Science: Physical Sciences, D-2
The ultimate source of most of the energy we use is the sun.

Science: Physical Sciences, D-1
Energy is required when work is done on a system or when matter changes its form.

OBJECTIVE

Based on observations they make about their own bodies after running, students develop and write general statements about how to tell when energy is being used.

BACKGROUND INFORMATION

Solar energy probably is not a direct source of the energy your students use. In this activity students look at the ways they use energy every day, a focus that will continue throughout the remainder of the unit.

There are several things to look for when trying to determine if energy is being used. One way is to check to see if heat is being produced. Almost all common uses of energy give off some heat as a by-product. For example, a light bulb in use becomes hot to touch, a refrigerator motor gives off heat, and a TV or radio gets warm if left on for a while. Many uses of energy also make something move or produce light. A washer spins, a TV lights up, and an alarm clock rings. (Other means of detecting when energy is being used, such as cooling and plant growth, are not covered in this activity.)

PREPARATION AND LEAD-UP

Write the headings "Produces Heat," "Produces Light," "Produces Sound," and "Causes Motion" separately on four pieces of butcher paper.

PROCEDURE

1. Ask, "What work did the sun do in the solar home experiments?" (It heated the air in the house.) Tell students that as part of their study of energy, you want them to use some of their body's energy to run around the track (or another appro-

priate area). Take the class outside and have them run as fast as they can for about three minutes. Return to the classroom.

2. Ask, "How did you feel after you ran? What changes did you notice in your body?" Most likely students will mention that they got hot. Explain that one of the signs that energy is being used is that heat is produced. Introduce three other methods of determining that energy is being used—motion, production of light, and production of sound. Post the four labeled sheets of butcher paper. Ask, "Which of these happened when you used energy by running? Which apply to the solar home experiments you did?" Have students record each of these uses of energy on the appropriate pieces of butcher paper (for example, running could be listed under "produces heat," "produces sound," and "causes motion").

3. Give students writing paper and have them write complete sentences that begin "I can tell energy is being used when . . . " Volunteers can share their writing.

4. Tell students that they will expand their study of energy by investigating ways they use energy every day (see the home learning suggestion).

DISCUSSION QUESTIONS

Where does your energy come from?
In what other ways besides running do you use energy?
Can you move something without using energy?
Is it possible for you to use absolutely no energy at all? Try it.

EVALUATION

Students' writings from step three can be used to evaluate their understanding.

EXTENSION IDEAS

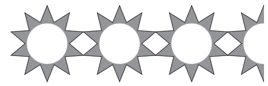
- Have students demonstrate something that uses energy and explain how they know energy is being used. You may want to allow students to bring props from home or require students to use materials (if needed) from the classroom.
- Have students record how their bodies get energy (foods and beverages) for one day. As a class, trace the direct energy transfers involved from the sun to a student's stomach. (For example, the sun provided energy for corn to grow, the corn provided energy for the chicken to live and grow, and the chicken provided energy for a student to live and grow. These energy transfers can be indicated with arrows: sun → corn → chicken → student.) Have students trace one of the foods they ate from the sun to themselves. Students can write and illustrate a short paper called "The Sun Gives Me Energy."

HOME LEARNING SUGGESTION
(Use as lead-up to the next activity)

Before beginning the next activity, students should go on an energy hunt of their homes. Have students list 10 or more ways they and their families use energy at home. Students should also list the sources of energy (such as electricity or natural gas) if possible. Students may wish to ask their parents about energy sources if they are unsure.

GRADES 4-6

Energy, Economics and the Environment—Elementary



Indiana Department of Education
Office of Program Development
Attn: Rose Sloan
Room 229, State House
Indianapolis, Indiana 46204-2798
317-232-9186
317-232-9121 (fax)

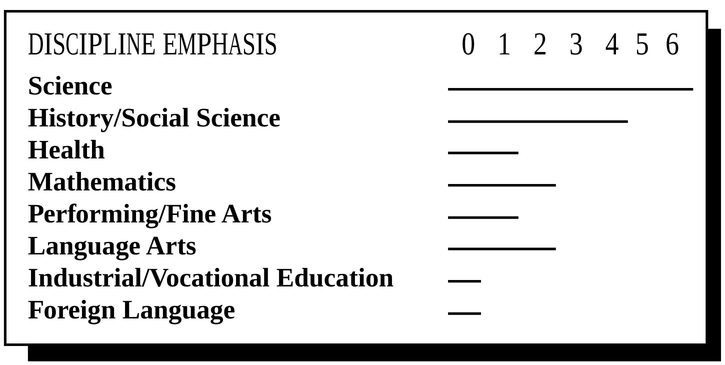
$8 per copy; 187 pages, 1994.

Grades 4-6

This curriculum provides a conceptual framework for analyzing energy and environmental issues, and provides teachers with four interdisciplinary teaching units.

REPORT CARD

Overall Grade	**B+**
General Content	**B+**
Presentation	**B**
Pedagogy	**B**
Teacher Usability	**B+**
Energy Content	**B**



COMMENTS

General Content
The lessons seemed to be focused primarily on economic issues.

Presentation
Some of the lessons are interesting and well written, and some are biased.

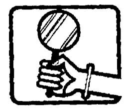
Pedagogy
Excellent lessons in decision-making through scenarios and personal energy use planning.

Teacher Usability
The length of lessons vary widely and may make scheduling difficult. Background on different types of energy resources is given in teacher information.

Energy Content
Discusses advantages and disadvantages of various energy resources.

Additional Evaluator Thoughts
Some information may be biased or inac-curate, such as page 155 under important concepts to emphasize: "We will never run out of oil or any other nonrenewable resources."

Activity 5



Further Explorations

Survey ten people in your community to find out:
a. Do you carpool, walk, or ride a bicycle to work or school?
c. Do you use any kind of public transportation to get to work or school?
d. Would you be willing to use these types of transportation? Why or why not?

Research the history of solar energy. How did ancient people use this form of energy? What developments have taken place in the past 100 years? Why isn't it used more today?

Research the term "mass transit system." Where are these systems currently being used? What are the advantages and disadvantages?

Prepare a report on how electricity is generated on wind farms. Describe and draw the different types of wind generators. What are the advantages and disadvantages of these farms? Where are current wind farms located?

Explain how a hydroelectric power plant operates. Label your diagram. Identify some of the environmental concerns about constructing this type of power plant.

Research the location of coal deposits in the United States. What economic impact does coal mining have in different regions of the country, including Indiana. What are the different types of coal? How are they different? Where are they located?

Research the advantages and disadvantages of using wood as a fuel. Investigate how wood was used in the past and how it is used today. Research some of the new trends in wood use, including the new "super trees."

Research which countries of the world rely on nuclear energy. Why do they do so? What do they do with the radioactive waste. How efficient is electricity produced using nuclear power? Have there been any safety problems with this type of energy?

Investigate the cost of electricity in your community. How does it compare with the cost in other communities, states, and regions of the United States? How is electricity use measured?

Research natural gas supplies in your community. How is it transported? Where are natural gas resources located? How is natural gas use measured? What is the cost of natural gas? How does the cost compare with other energy sources?

Activity 6

Let's Talk It Over

Energy efficiency in the United States has improved greatly during the past 25 years. For example, from 1970 to 1993:

* Per capita energy consumption declined from 340 million Btu's to 323 Btu's.
* Energy consumption per dollar of Gross Domestic Product (GDP) declined from 23.12 to 16.73 thousand Btu's.

However, because the United States is such a large country and consumes a large amount of energy, some individuals believe that the United States is not doing enough to increase its energy efficiency. Below are some controversial statements for your students to discuss/debate. Help students think critically by applying the concepts learned in this unit.

<u>To increase energy efficiency and help conserve our energy resources:</u>

1. Schools should close during December and January and open in June and July, with no air conditioning allowed.
2. Everyone should be required to keep their thermostats at 68 degrees.
3. All students must take the school bus if they don't walk or ride bicycles.
4. Families should not be allowed to own more than two vehicles.
5. The tax on gasoline should be raised significantly.
6. Large car and van owners should pay an extra "large vehicle tax."
7. The driving age should be raised to 21 so fewer people would be driving cars.
8. Car companies should be required to produce a solar powered car.
9. People should be required to purchase solar powered cars, even if they cost more, have less power, have less passenger and storage space, and are not as safe because of their smaller size.
10. Electric companies should be required to generate some of their electricity using wind or solar power, even if this means higher electric bills for customers.
11. We should let the market price of energy guide the energy decisions of producers and consumers. We should not restrict the freedom of choice in energy matters.

Teach With Energy!

National Energy Foundation
5225 Wiley Post Way, Suite 170
Salt Lake City, Utah 84116
801-539-1406/ 1-800-616-TEAM
801-539-1451 (fax)
e-mail: info@nef1.org
http://www.nef1.org

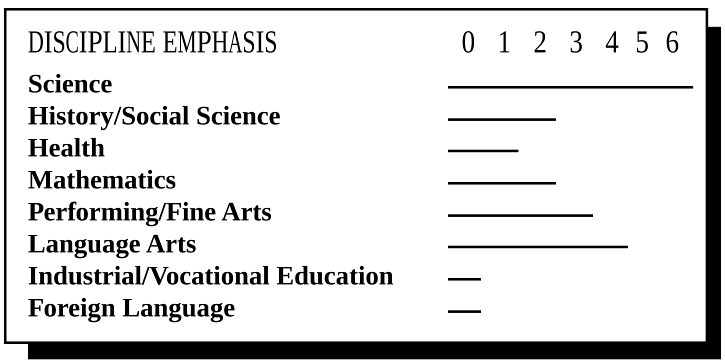
Item #11TWE4-6: $15 per copy; 143 pages, 1992. Teachers receive a 20% discount upon request. *Teach With Energy*! also available on the web for $15.

Grades 4-6

An energy, electricity, and science resource guide for teachers.

REPORT CARD

Overall Grade	**B**
General Content	**B+**
Presentation	**B**
Pedagogy	**B**
Teacher Usability	**A-**
Energy Content	**B**



COMMENTS

General Content
This curriculum seems appropriate for the grade level of understanding.

Presentation
Great graphics—they really help students better understand the written content.

Pedagogy
Few hands-on learning experiences where students explore ideas presented. Contains specific evaluation ideas.

Teacher Usability
Variation in time allotment (30-60 minutes) might pose some scheduling problems. Great background information on renewable/nonrenewable energy sources.

Energy Content
The only page for renewable energy sources doesn't have graphics, is brief on information and not well written.

Additional Evaluator Thoughts
The career awareness notes on several of the lessons is a useful addition.

Solar Collectors

Activity 16

Science, Mathematics, Art, Language Arts	Conversions	Grades	Time
		4-6	3x45 min.

Concept

The efficiency of energy conversion systems differs.

Activity Goal

The students will explain that solar collectors of different colors and absorption mediums will convert solar energy to heat energy at different efficiencies.

What You'll Need

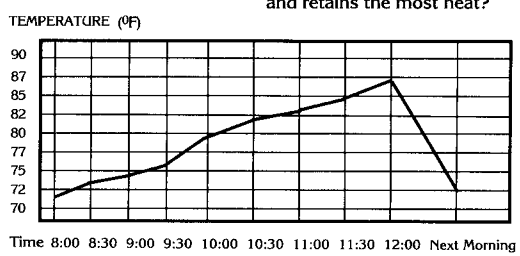
- Various colors of poster paint - flat, not glossy
- At least 8 cans the same size
- Plastic wrap
- Tape
- Dirt, sand, gravel, styrofoam, saltwater to fill cans
- Thermometers

What To Do

1. In small groups have students select a color (black should be one of the colors) from those available and paint a can. The cans should be of the same size.

2. Fill each can half full of cold water and cover with plastic wrap. Use tape to hold plastic wrap in place. Insert a thermometer to measure the temperature of the water. Place cans in the sunlight for several hours. Measure water temperature at 30-minute intervals and the first thing the next morning.

3. Students will then prepare graphs to plot temperature against time, at 30 minute intervals. See sample graph below.



4. Repeat the above using different heat storage mediums: dirt, gravel, sand, saltwater, styrofoam. Use unpainted cans.

5. Discuss with students the results of the investigations. Ask:

A. Which color(s) absorbed the most heat energy? Why?

B. Which storage medium absorbed the most heat energy? Why?

C. Which color and storage medium retained its heat energy the best?

D. Which system is the most efficient?

E. What combination of color and storage medium would you think absorbs and retains the most heat?

F. How might you use what you have learned in the investigations to obtain energy for use in your home?

6. Divide students into groups to research one of the following solar energy technologies and prepare an oral report. They should include drawings, describe how the technology works, its feasibility, how the sun is used and other advantages and disadvantages.

A. Solar ponds

B. Power towers

C. Ocean thermal energy conversion systems

D. Photovoltaics

E. Passive solar technologies

F. Active solar technologies

G. Wind energy

H. Tidal energy

Career Awareness Idea

Invite a speaker who works in the area of solar energy to speak to the class about his/her job.

Evaluation Idea

Have the students explain how they would apply what they have learned from the investigations to heat water for their home.

The Universal House

California Energy Commission
Education Information
1516 Ninth Street, MS 29
Sacramento, CA 95814
916-654-4982
916-654-4420 (fax)
http://www.energy.ca.gov/education

$1.50 per copy; 36 pages, 1992.

Grades 3-6

This guide links energy awareness with resource management and traditional California Indian cultures for students in grades 3-6.

REPORT CARD

Overall Grade	**B**
General Content	**B+**
Presentation	**B**
Pedagogy	**B+**
Teacher Usability	**B**
Energy Content	**B-**

DISCIPLINE EMPHASIS	0 1 2 3 4 5 6
Science	
History/Social Science	
Health	
Mathematics	
Performing/Fine Arts	
Language Arts	
Industrial/Vocational Education	
Foreign Language	

COMMENTS

General Content
This great resource ties together social studies units on Native Americans with science units on energy and architecture.

Presentation
Photos of the different types of Native American structures and innovative methods of insulation relay a visual message.

Pedagogy
Involves students in a variety of hands-on/minds-on activities which encourage critical thinking.

Teacher Usability
The objectives and time frames for each lesson are clearly defined. Could use additional background information on California Indians.

Energy Content
Good lessons on the energy conservation principles of home/dwelling orientation, shading, insulation, and thermal mass.

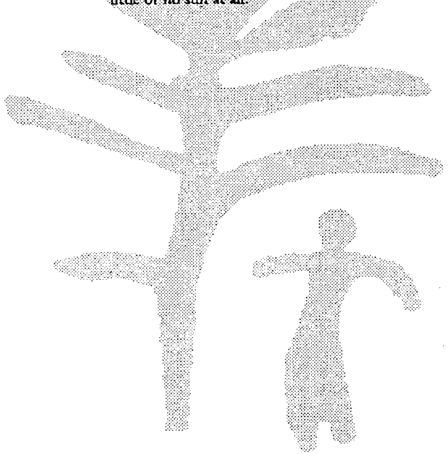
Additional Evaluator Thoughts
Values the wisdom of native people's simple home building as energy efficient and energy wise.

SHADE

DEFINITION

shād
Shade results when sunlight, solar energy, is blocked or inhibited. From the Greek—*Skotis* meaning darkness.

In summer, California Indians not only took advantage of natural shade, they made their own shade with open-air shelters. The sun's energy heats everything in its path, even air. Interrupting or blocking this energy creates shade (diminished light and heat). To cover a space without enclosing it provides shade, circulation of fresh air (ventilation), and protection from solar radiation. Thermal energy is most intense on a structure's south and west faces, and when the sun is directly overhead. The angle and intensity of its rays vary from hour to hour, season to season, but as this variation is cyclical, shelters can be planned and managed to benefit both human comfort and the environment. Relative size and position of structural openings (windows and doors) and sun blocks (roofs, overhangs, window coverings, awnings, walls, trees, etc.) affect the absorption and retention of thermal energy. When it comes to energy efficiency and cost effectiveness, sometimes the best relationship with the sun is a cautious one—little or no sun at all.



SCIENCE FRAMEWORK CONNECTION

Physical Science
E. Energy: Heat
E1. What is heat energy? (page 64)
E2. How do we use heat energy? (page 64)
G. Energy: Light
G1. What is light energy? (page 72)
G2. What are the properties of light? (page 73)

Earth Science
A. Astronomy
A1. How do the objects of the universe relate to one another? (page 79)
B. Geology
B1. What are the responsibilities of humans toward natural resources? (page 97)

Life Science
A. Living Things
A4. How do humans interact with other living things? (page 125)

SHADE

OBJECTIVE
To demonstrate the role that shade plays in the prevention of heat gain.

MATERIALS
Cardboard, scissors or utility knife, ice cubes, ziplock plastic bags, sun.

TIME
50 minutes (near midday).

STUDENTS' PRECONCEPTION
Guide students in visualizing and describing the conditions, cause and effect of a shaded environment in a warm climate. Have them describe the same environment without protection from the sun (especially at midday). Ask the students to predict in which environment (sun or shade) the ice cube will melt more quickly. Why?

PROCEDURE
Cut a rectangle of cardboard measuring 11" x 14", plus 2 squares measuring 6" x 6". Fold the rectangle in half at a 90 (degree) angle to form a cardboard "roof" or sunscreen. Place both squares of cardboard in a sunny location and put an ice cube (in a plastic bag) on each. Immediately place the cardboard roof over one of the ice cubes. Be sure not to shade the other ice cube with your body! After 30 minutes, measure the amount of water that has collected in each bag.

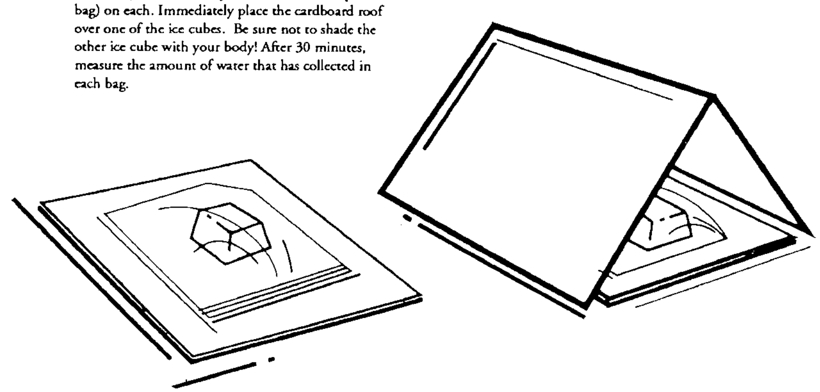
CONCEPTUAL CHALLENGE
Which ice cube melted more quickly—the one in the shade, or the one without protection? Which ice cube absorbed the most thermal energy? Why? What was the source of this energy? What is shade a result of?

APPLICATION
☼ Ask students to illustrate shade with drawings showing a "sunscreen" of their choice blocking the sun and creating shade.

■ Ask students to break into groups and compose lists of as many sources of shade as they can think of that block the sun's heat from their homes, thereby reducing the need for cooling their homes in the summer. Compare lists.

○ Is the moon ever a source of shade? (Diagram a solar eclipse on the blackboard to demonstrate how sunlight is dimmed or eliminated by the moon.)

☼ Discuss where the energy needed to cool a home without sufficient shade comes from.
Can shade be grown? What kinds?



People Power

The Energy Source Education Council
Program Distribution Office
5505 E. Carson Street, Suite 250
Lakewood, CA, 90713-3096
562-420-6814
562-420-1485 (fax)

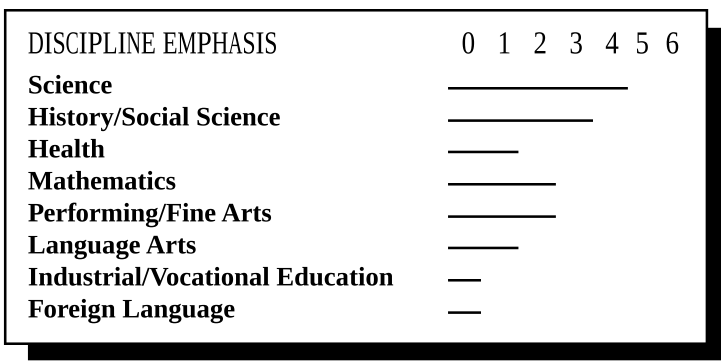
Class set $65 (Includes a 52 page teacher's guide, video, IBM-compatible computer disk, 35 copies of student materials, and other support materials); 1995.

Grades 5-6

A ten-lesson program that combines classroom instruction with student opportunities for positive, real-life behavior change.

REPORT CARD

Overall Grade	**B**
General Content	**B**
Presentation	**B**
Pedagogy	**B-**
Teacher Usability	**B**
Energy Content	**B+**



COMMENTS

General Content
Personal energy plan is a good way to start the student thinking about a personal commitment to saving energy.

Presentation
This curriculum is presented in a fairly conventional manner, except for the addition of a video and a disk.

Pedagogy
No hands-on, experiential learning activities.

Teacher Usability
Includes teacher background and basic facts at back of booklet. The parent take-home survey is a good way to involve the parents with energy conservation awareness.

Energy Content
A good treatment of future consequences of wasteful use of energy resources through a video and student follow up.

LESSON 9: Home Energy Reports

Materials:
- Completed Home Energy Survey for each student
- IBM or IBM-compatible computer with Windows, if available
- Energy Report Disk
- Home Energy Report for each student (computer-generated or teacher-generated; see procedures in Appendix B on pages 40 and 41)
- Copy of PEOPLE POWER Review Exercise for each student (page 38 in this guide)

Procedures

A. Discuss Home Energy Surveys

- Have students get out their Home Energy Surveys. Ask various questions from the Home Energy Survey (see suggestions below) and have students raise their hands to respond. Record on the chalkboard the number of students giving each response.

  2. Who has a gas heating system at home? Electric? Oil?

  4. Who keeps their thermostat at or below 68° in winter? Above 68°?

  5. Who has central air conditioning? No air conditioning?

  6. Who keeps their thermostat at or above 78° in summer? Below 78°? No thermostat?

  10. Who has more than one refrigerator in their home? One refrigerator?

  17. Who drives their car or cars less than 10,000 miles? Between 10,000 and 20,000? Between 20,000 and 30,000? More than 30,000?

- Discuss findings from the survey items with the students. Use the numbers recorded on the chalkboard to note energy-use patterns in the students' homes. Discuss questions such as "Is the thermostat set below 68° or above 68° in winter in most of your homes? Which setting saves energy?" Etc.

B. Discuss Home Energy Reports

- Hand out or have students get out their Home Energy Reports. Ask them to look over their reports, noting the energy-saving actions that are recommended on it for their family.
- Tell students that you are going to summarize the recommended energy-saving actions for the class. Use the Home Energy Report on page 43 of this guide and read each recommended action listed one at a time. For each action, ask the students to raise their hands if they have that recommended action listed (or checked) on their reports. *(**Note:** The Refrigerator–#5–actually has **two** actions listed—replace an old refrigerator **and** use only one refrigerator. If students have computer-generated reports, these two actions will be shown separately.)* List the action name (e.g., Heater Maintenance) or icon (e.g., Repair Man) on the chalkboard and record the number of students who raise their hands for each recommended action.

  *(**Note:** If students have computer-generated reports, and if their Home Energy Surveys show generally wise energy use, several icons may appear, or appear again, with recommendations not listed on the hand-generated report. Ask students if any of them have "extra" recommendations listed next to the following icons:*
  - Light Bulb
  - Car
  - Recycle Symbol
  - Refrigerator
  - Shower
  - Water Heater
  - Repair Man
  Be sure to read these "extra" recommendations.)

- Discuss the summary results with your students. Ask questions such as:
  — Which energy-saving actions were recommended most often? Why do you think these were the ones?

  — Which ones do you think would save the most energy or provide the most Eco-Benefits? Why?
  — Which actions from your list would be easiest for your family to take?
  — Which actions from your list would be easiest for you to help with? How?
- Tell students to take their Home Energy Reports home to share with their parents.

C. Review the content of the PEOPLE POWER unit

- Inform the students that they will take a test on the PEOPLE POWER unit in the next lesson. Tell them that they are now going to do an exercise reviewing some of the content of the unit. Emphasize that doing well on the review exercise should help them on the test.
- Make a copy of the PEOPLE POWER Review Exercise on page 38 in Appendix A for each student. Have the students complete it on their own.
- Correct the exercise in class using the answer key on page 39.

D. Conduct enrichment activities (optional)

- **Investigate energy costs.** Bring to school recent monthly bills for electricity, natural gas, heating oil, and gasoline. Have students figure the total monthly cost for their family for energy. (You can also have them figure the total cost for the class if you wish.) Try to determine how much money could be saved by cutting down on energy use.
- **Write conservation ads.** Have your students work in small groups to write and illustrate television advertisements that encourage Americans to save energy. Have students act out their ads for the class.
- **Take a field trip.** Arrange for a field trip to an electric power company or, if possible, an electric power plant in your area. Find out what energy source(s) the company uses to supply your electricity. If possible, observe the process of electricity being generated. Ask what actions that the utility takes to help protect the environment, what the actions cost, and who pays the cost.

Let's Get Energized!

California Energy Commission
Education Information
1516 Ninth Street, MS 29
Sacramento, California 95814
916-654-4989
916-654-4420 (fax)
http://www.energy.ca.gov/education

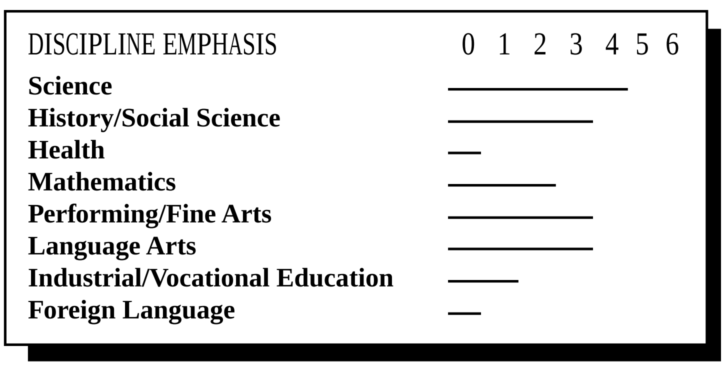
$1.50 per copy; 136 pages.

Grades K-6. Evaluation based on review of materials for grades 4-6

A collection of energy education and awareness activities designed for after-school enrichment/childcare programs.

REPORT CARD

Overall Grade	**B**
General Content	**B**
Presentation	**B**
Pedagogy	**B**
Teacher Usability	**B**
Energy Content	**B**



COMMENTS

General Content
Interdisciplinary—many language arts, fine arts, and physical (movement) activities that relate to energy concepts.

Presentation
This may be difficult to implement in a classroom. The table of contents is organized in a useful way.

Pedagogy
The challenge labs are especially good activities.

Teacher Usability
Includes a short list of where activities were adapted from. Well organized for use by teachers.

Energy Content
Could use more background on energy resource concepts.

Additional Evaluator Thoughts
Provides energy education activities in an after school format—fun and practical.

Muffin Mining

Objective: Students can describe the advantages and disadvantages of 2 types of coal mining.

Preparation:
1) Buy or make one chocolate chip or raisin muffin (without wrappers) for every student
2) Make a copy of the "Dig It" worksheet (enlarge it if you can)
3) Gather mining materials.

Materials:
1 toothpick/student
scissors or tweezers for each pair or group
a paper plate for each pair or group

Time Frame: 30 minutes
Suggested Audience: grades 2 to 6

Procedure:
1) Explain to students that they will conduct an experiment to find out how coal is mined and the effects of mining on the environment. The reason for doing this activity is because coal is our most abundant fossil fuel, so it's important to understand what we have to do to use this energy resource.
2) Show students the DIG IT information sheet. Read the facts about coal and then as a group, list those facts which are "Advantages" or "Disadvantages" as shown on the worksheet. (Answers from top to bottom are D,D,A,A,D,A,D.)
3) You will now describe the two types of coal mining using the pictures on the DIG IT sheet. In **strip mining**, large areas of land are scooped up and then sorted through. In **underground mining**, tunnels are dug underground in an area where they think there is a large deposit of coal. Each student is going to have an opportunity to try both methods of mining and decide which they think is the best method.
4) Tell students that no one is to touch their muffin until you have told them to do so. They may eat their muffin *after* the experiment.
5) Pair students up. You may want a younger and older student together. Pass out a muffin to each pair of students (you can use oatmeal raisin for those students who are allergic to chocolate).
6) Have students examine their muffin and estimate how many chips/raisins are in it. Record each group's predictions on the chalkboard. The students will now **strip mine** their muffin. Demonstrate that they do this by taking a section and breaking up until they find every chip/raisin. They are NOT TO EAT ANY OF THEIR COOKIE yet. Record the actual number of chips/raisins found in each muffin on the board. The actual number of chips/raisins should be higher in most cases. Discuss with students the "condition" of their muffin. Equate their muffin crumbs with what the land would look like after strip mining (devastation). Explain that while strip mining is a better method for getting lots of coal, it

damages the land so badly that living things often can not live there.
7) Ask students to set the strip mined muffin crumbs and chips aside. After they've done this give each group a second muffin. (Remind them, not to eat until the experiment is done.) Now the students will do underground mining to get the chocolate chips/raisins out of their muffin. First record the estimated number of chips/raisins. This time students are to carefully remove the chips/raisins **without damaging the muffin**. (KEEP IT IN ONE PIECE.) If the students see a chip/raisin and they can get it without breaking their muffin then they should try to mine it. If a student breaks their muffin they must stop mining because they have done too much damage to the land. Again, record the number of chips found. (There should be a smaller yield.)
8) As students underground mine their muffin for more chips, talk with the group about the advantages and disadvantages of the two mining methods. Which method does each group think is best? Why? (Look back at the advantages and disadvantages for each from DIG IT.)
9) Allow students to eat their muffins.

Adapted from: IDEAS, Iowa State Dept. of Education, 1987

Science Alive! Unit 1 Energy Flow

Science Oriented Learning
1324 Derby Street
Berkeley, CA 94702
510-644-2054
510-642-1055 (fax)

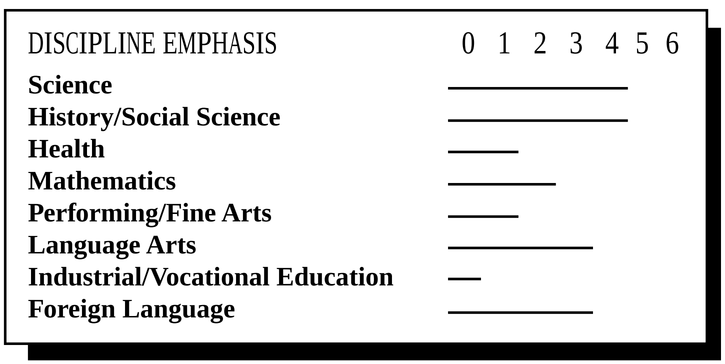
$25 per volume, $115 per set, plus 10% shipping and handling, plus tax; 183 pages, 1988.

Grades 4-6

Designed with the busy teacher in mind, the program requires no scientific background, little preparation time and few, inexpensive materials, and offers a simple, effective approach which makes science easy and fun to teach.

REPORT CARD

Overall Grade	**B**
General Content	**B+**
Presentation	**B**
Pedagogy	**B-**
Teacher Usability	**C+**
Energy Content	**B-**



COMMENTS

General Content
Multicultural, historical, and inter-approach.

Presentation
Good variety of lessons all of which have Spanish-translated student pages.

Pedagogy
This curriculum uses a systems approach throughout the unit. There are many traditional dittos whose formats are not challenging.

Teacher Usability
All student lab sheets are available in Spanish.

Energy Content
Describes the energy present in plants, animals, and food, and explores how humans use energy in a basic, introductory fashion.

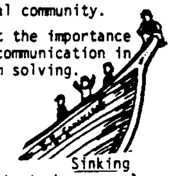
Additional Evaluator Thoughts
There is an energy and exuberance about this curriculum which is quite energizing. It feels like it was created with the idea of making learning enjoyable.

SINKING SHIP

DESCRIPTION: Students must work together to choose five or ten given items, that will enable them to survive in a different cultural community.

GOAL: To highlight the importance cooperation and communication in community problem solving.

TRANSITION:



Sinking ship asks students to become cultural ambassadors throughout the world.

BACKGROUND: Cooperative problem solving is the name of the game here. In six different versions, students role play the crew salvaging the most important items on board before their ship goes down. Each version offers a comparison and contrast between long-term and short-term community planning (i.e. a gun with six bullets vs. a pair of rabbits) as well as between different cultures (i.e. Anglo, Mexican, Chinese, Indian, African, and Native American). After playing one version and learning the activity structure, subsequent versions can be played in one half the time.

To add excitement and realism to the game bring "survival" items (i.e., dictionaries, jugs of water, Atari video) to the classroom. This would serve the younger grades (1-3) well for it adds a concrete element to an abstract role play.

ACTION:

1. Divide students into groups of six.
2. Read the following script.

   On a field trip, you and three friends went on a boat to see some islands in the ocean. Your boat is now near a large island. We know that there are no people on it. We do not know if there are animals on this island or if there is water on the island. From your boat you can see that there are some trees and greenery on the island. SUDDENLY, the boat scrapes a large rock. It tears a hole in the bottom of the boat! The boat will sink in 30 minutes. Fortunately, there is a small lifeboat. You can use this lifeboat to reach the shore of the island but it is not big enough to sail all the way back home. Your lifeboat can hold your crew and 5 things that your group chooses to take from the larger boat. Remember you have just 30 minutes to survive . . .

   En una gira de investigación tú y tres amigos se fueron en un barco a ver unas islas. (Escoge tres amigos para leer el resto de este cuento). Tu barco navegó hasta llegar cerca de una isla grande. Sabemos que esta desierta, no hay ninguna gente en ella. No sabemos si hay animales, o si hay agua en la isla. Desde el barco puedes ver que hay algunos árboles y alguna vegetación. De repente, el barco se raspa contra una gran roca y se hace un hoyo en el fondo. El barco se va a hundir en treinta minutos. Afortunadamente, hay un pequeño bote de salvamento. Puedes usar este bote de salvamento para alcanzar la orilla de la playa, pero no es lo suficientemente grande para navegar hasta regresar a casa. Tu bote de salvavidas solamente tiene espacio para ustedes cuatro, y para cinco cosas que tu grupo escoja llevarse del barco. Recuerda que nada más tienes treinta minutos para salvarte. ¿Cuales cinco cosas escojerá tú grupo? Deben de cooperar y tomar una decisión juntos.

NAME ______

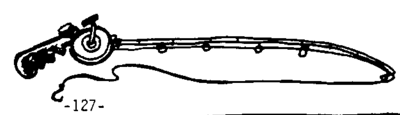
SINKING SHIP
Renewable VS. Non-Renewable

Help! The ship is going to sink. We must rescue supplies in order to survive. Your lifeboat can hold crew and five things your group chooses to take from the Sinking Ship. Remember, you have just thirty minutes left.

1. 5 cans of Sterno
2. One Solar Oven
3. One six-pack of Coca Cola
4. One four foot square piece of plastic
5. 50 pounds of hamburger
6. One pair of chickens
7. One fishing rod and reel
8. One loaded gun
9. One Mercedes Benz
10. One burro

List the five (5) things your group chose, then explain why you chose them:

WHAT	WHY
1. ______	______
2. ______	______
3. ______	______
4. ______	______
5. ______	______



GRADES 4-6

Renewables Are Ready: A Guide to Teaching Renewable Energy in Jr and Sr High School Classrooms

Union of Concerned Scientists
Publications Unit
Two Brattle Square
P.O. Box 9105
Cambridge, MA 02238-9105
617-547-5552
617-864-9405 (fax)
http://www.ucsusa.org

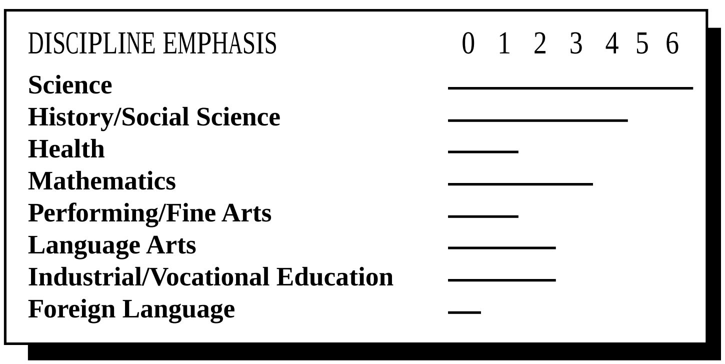
$5 for single copies, $3 each for orders of 10 or more. Add 20% for shipping and handling. 101 pages, 1994.

Grades 7-12. Evaluation based on review of materials for grades 7-9

This guide is intended to introduce students to renewable energy technologies and to the political and economic conditions necessary for their implementation.

REPORT CARD

Overall Grade	**A**
General Content	**A**
Presentation	**A-**
Pedagogy	**A**
Teacher Usability	**A**
Energy Content	**A**



COMMENTS

General Content
Action projects personalize the issue and solutions. Balances science and social studies; even addresses economics. Very thorough.

Presentation
Activities are well thought out to teach a single concept, and are grouped to explore renewable/nonrenewable energy in a short, comprehensive way.

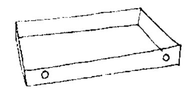
Pedagogy
Good balance of hands-on, concrete activities including role playing public discourse. Good, embedded, authentic assessment.

Teacher Usability
Comprehensive teacher resource section is short, sweet, high powered and not easy to read and use.

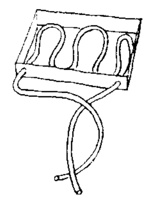
Energy Content
Addresses renewable energy.

How to Build a Solar Water Heater

1. Poke two holes in the box at opposite ends of one side. Make them the size of the tubing you will use. Glue aluminum foil on the inside of the box and paint the box black inside.



2. Insert tubing through one hole and curl it around the bottom of the box. Poke the tubing out the hole at the other end. Leave roughly equal amounts of tubing sticking out of both ends of the box.



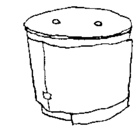
3. Paint the tubing inside the box completely black.

4. If the tubing does not stay at the bottom of the box, pin it down. Do this by bending a paper clip. Stick it around the tubing through the bottom of the box. Bend the clip ends on the other side, clamping the tubing down. Tape a thermometer to the bottom of the box.

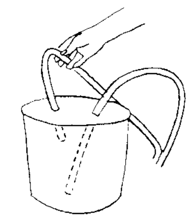
5. Cover the box with plastic wrap, glass, or Plexiglas. Tape it on so that it is airtight. If you use plastic wrap, stretch it so that there are no wrinkles.

How to Build a Solar Water Heater

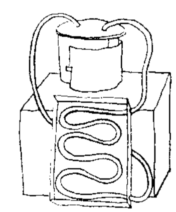
6. If the buckets you use do not have tops, make tops out of cardboard. Insulate the buckets by taping sheets of newspaper around them. Poke two holes in the top of one of the buckets for the tubing. This is your experiment bucket. The other bucket will be your control.



7. Fill both buckets with water. Insert tubing in your experiment bucket. Make sure that one end of the tubing is near the top, the other at the bottom. You may need to cut off some excess tubing to do this.



8. Prop up the box at a slant so that it is facing the sunlight (its shadow should be directly behind it). Place the experiment bucket on some support (books or another box will work), so that it is *completely* above the level of the collector. Arrange the control bucket at the same level.



9. Suck on one end of the tubing in the control bucket to fill the water pipe with water. Make sure there is no air in the pipe when you insert it back in the water.

10. Leave the solar heater and control bucket out in the sun for 1 or 2 hours and measure the temperature of the water periodically, as well as the temperature inside the heater.

Environmental Science Activities Kit

Prentice Hall
Order Processing Department
P.O. Box 11071
Des Moines, Iowa 50336
515-284-6751
515-284-2607 (fax)
http://www.phdirect.com/phdirect

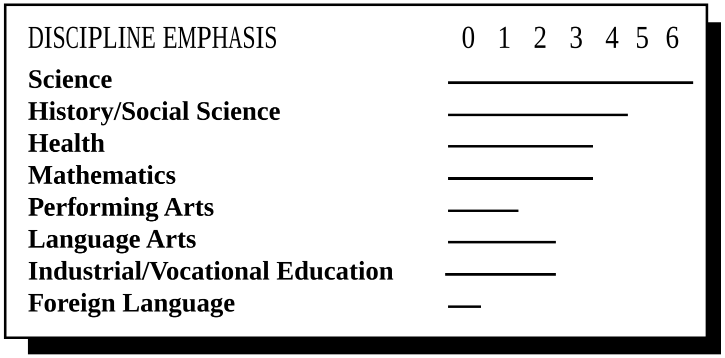
$29.95; 332 pages, 1993.

Grades 7-12. Evaluation based on review of materials for grades 7-9

Thirty-two interdisciplinary science lessons organized into six topical units focusing on major environmental issues.

REPORT CARD

Overall Grade	**A**
General Content	**A**
Presentation	**A-**
Pedagogy	**A**
Teacher Usability	**A**
Energy Content	**A**



COMMENTS

General Content
Gives a comprehensive view of the topic with a variety of lessons to choose from. Thorough coverage of each topic.

Presentation
Layout is clear and easy to follow. Pictures and graphics are needed.

Pedagogy
Paper and pencil intensive. Assessment imbedded but dependent on a worksheet. Lesson styles provide limited diversity to accommodate different learning styles. Extends critical thinking.

Teacher Usability
Teacher background information and preparation instructions are extremely helpful. Good for new teachers. Easy to obtain materials.

Energy Content
Practical development of several concepts related to energy applications.

Additional Evaluator Thoughts
Kids would love doing these activities. Fun and educational.

21.1 Catch the Sun!: Background Information

People have always used the sun as a heating source. When we open our window curtains to let the sun in, we are using **solar** energy. When we burn wood in our fireplaces, we are using solar energy that has been stored by trees. Even when we use oil, coal, or natural gas to heat our homes, we are using solar energy that has been stored in these **"fossil fuels"** for millions of years. Since most of our electricity is generated by burning fossil fuels, even most of our electricity is generated by stored solar energy!

As the price of **nonrenewable** fossil fuels increases, and as people become more aware of and concerned about the environmental problems caused by fossil fuels and nuclear power, people are looking more closely at using solar energy for heating their homes. Solar energy can be used to produce electricity, heat water, cook, or even to cool homes!

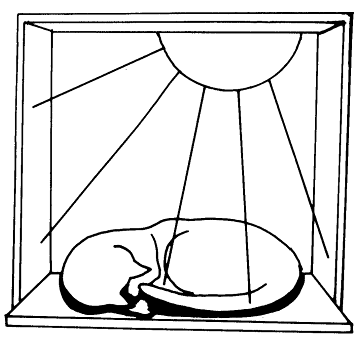
When we use solar energy without electrical devices to increase circulation, it is called **"passive"** solar technology. A simple window is an example of a passive solar energy collector.

When we use fans or pumps to circulate the heated air or water, that is called **"active"** solar technology. Many rooftop solar water heaters use pumps and so are referred to as active systems.

There are about 500,000 homes in the United States that have passive solar designs. Many of these homes are not in the southern states where one might expect them to be more common. In fact, effective, affordable, and comfortable solar-heated homes can and have been built in most areas of the United States. As energy costs increase and new designs and technology become available, more solar homes will be built.

Solar energy can be focused on materials to be burned or melted in a furnace. It can also be focused on boilers to produce steam to generate electricity. There are several places in the world, including some in the United States, where solar energy is currently being used to generate electricity commercially. A 200-megawatt plant near Los Angeles produces enough electricity for 270,000 people. Such plants cost no more than nuclear power plants, take much less time to build, use a renewable energy source, and do not produce dangerous nuclear by-products.

Solar energy can be converted directly to electricity by solar cells (photovoltaic cells). You have probably seen or used a calculator that is powered by a solar cell. Groups of cells can be coupled together to form panels that can be mounted on houses, cars, and even airplanes! They provide electricity that can be used immediately or stored in batteries. Photovoltaic technology is advancing rapidly, and electricity produced by solar cells may soon be competitive with other sources of electricity. It already is competitive in out-of-the-way places where it is not economical to run electrical lines.



Name ______________________ **Class** __________ **Date** __________

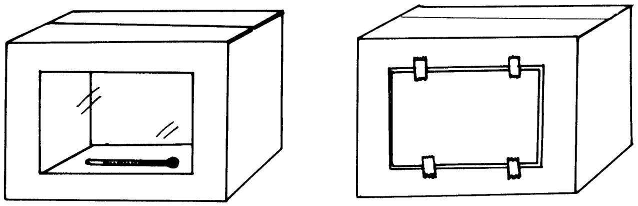
21.2 Catch the Sun!: Instructions

In this activity, you will use cardboard boxes to construct two "homes." Each will have a plastic "window." One home's window will be covered with cardboard. You will then place your homes in the sun and record the air temperature inside of each for 30 minutes.

Your teacher will explain how to construct your "home."

When you cut the cardboard out to form the windows, save one piece to use as a window cover.

The thermometer can either be placed in the home where it is visible through the window, or it can be suspended in the "ceiling" (box top) in such a way that the bulb is inside the home near the ceiling and the temperature can be read from the outside of the box.



When the thermometer has stabilized, record the starting temperature in each "home." Then place both "homes" in the sun with the windows facing toward the sun. Be sure to place them in a place where they won't become shaded before they have been in the sun for 30 minutes.

Record the temperature of each house every 5 minutes for 30 minutes.

GRADES 7-9

The Energy Sourcebook

TVA Environmetal Research Center
P.O. Box 1010, CTR 2C
Muscle Shoals, AL 35662-1010
205-386-2714
205-386-2126 (fax)

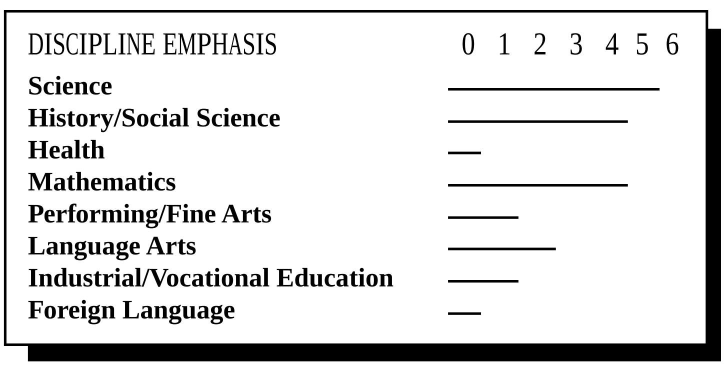
$35 each; 1992.

Grades 7-9

The “Sourcebook” includes six chapters of six to nine activities each; activities can stand alone or be combined with lessons from different chapters.

REPORT CARD

Overall Grade	**A**
General Content	**A**
Presentation	**A**
Pedagogy	**A-**
Teacher Usability	**A**
Energy Content	**A**



COMMENTS

General Content
Subtle wit and thoroughness characterize these appropriately developed lessons. Good activities, good extensions, includes lessons on sustainability.

Presentation
Features concise, well organized lessons that list objectives, times, adequate background, interdisciplinary connections, and materials all on the front page.

Pedagogy
Good diversity in instructional strategies. Lessons exercise higher level thinking skills and problem solving. Provides good mix of classroom and field activities and wide variety of discovery-based activities.

Teacher Usability
Many materials required for some units/ lessons. Excellent and copious background for teachers. Objectives (most in behavioral terms) with each lesson.

Energy Content
Thoroughly develops each major facet of energy.

CONSTRUCTION AND OPERATION OF A STEAM TURBINE MODEL (continued)

5. NOTE: To simplify this demonstration, set the flask on a hot plate rather than burning coal to heat the water. If you use a hot plate, make sure the students understand that the heat from the hot plate functions just as the heat from either a burnable fuel or nuclear fuel functions in a power plant.

II. Operation of the model

CAUTIONS: Wear goggles! Use an operative fume hood. Practice safety rules! Make sure the opening of the tube is directed away from you and towards the turbine. Steam can cause serious burns.

A. Light the burner (or turn on the hot plate) and heat the crushed coal. When the coal begins to burn, turn off the burner or hot plate.

B. Direct the steam emerging from the end of the nozzle toward the turbine blades, and observe as the turbine spins.

III. Questions to ask the students

A. Have the students trace the transfer of energy from the coal to the turbine. Make sure they can identify the following:

1. Where energy changes from potential to kinetic energy.
2. Where chemical energy is found.
3. Where mechanical energy is found.
4. Where heat energy is found.
5. Where light energy is found.

(Modify your questions if you use a hot plate rather than coal.)

B. Ask the students what happens to the chemical energy from coal when we burn it to operate this model.

C. Have the students describe how the production of electrical energy relates to this model.

Teacher

CONSTRUCTION AND OPERATION OF A STEAM TURBINE MODEL (continued)

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C. Have the students describe how the production of electrical energy relates to this model.

P-28

Canadian Energy Issues

Mike Bergin
Ottawa Board of Education
56 Herridge St.
Ottawa, Ontario
Canada K1S 0G9
613-733-4860 (bus)
613-233-5051 (home)

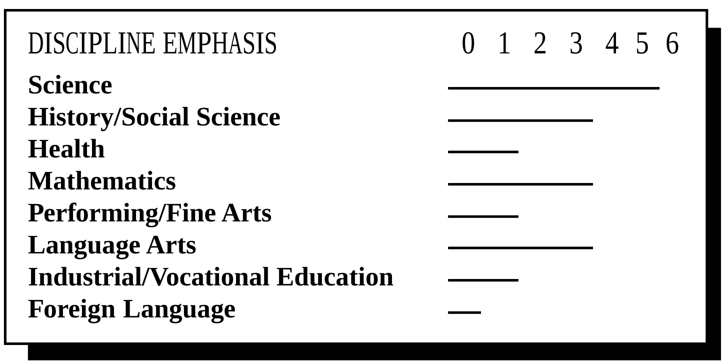
$20 per copy; 267 pages, 1992.

Grade 9

This unit is designed to be taught by a team of core subject teachers working with the same group(s) of students in a particular block of time in the school day.

REPORT CARD

Overall Grade	**A**
General Content	**A+**
Presentation	**A-**
Pedagogy	**A-**
Teacher Usability	**B**
Energy Content	**A**



COMMENTS

General Content
Very strong interdisciplinary component. Takes students from understanding major energy resources to visualizing a sustainable future through improved energy efficiency and alternative energy sources.

Presentation
Activities tend to look alike—one worksheet after another (even though the students are thinking!).

Pedagogy
Encourages higher order thinking skills. Addresses affective as well as cognitive domain. Imbedded assessment.

Teacher Usability
Appendices provide useful organizational strategies. Uses Canadian-specific statistics. Items available in French.

Energy Content
Extensive treatment of renewables.

Fusion

FUSION ENERGY TECHNOLOGY

* Tremendous challenge to harness and control power of nuclear fusion.

* Only natural occurrence is found in sun and stars. This is due to the following conditions:
  - strong forces of gravity
  - temperature of 17 x 10^6 °C

In these conditions, hydrogen atoms collide and fuse forming a helium atom, thus creating energy in the form of light and heat.

* Man made fusion requires isotopes of hydrogen-deuterium and tritium because this combination of hydrogen burns at a much lower temperature than the sun.

The ignition temperatures of various hydrogen isotopes		
Fusion Reaction	Energy of Reactants J/g (X 10^{10})	Ignition Temperature °C (X10^6)
D + T - ^{4}He + n	16.9	77
D + D - ^{3}He + n	4.0	773
D + D - T + p	4.8	386
D + ^{3}He - ^{4}He + p	17.7	620
D + ^{10}B - 3^{4}He	3.2	2300

A LAYMAN'S GUIDE TO HOW FUSION WORKS

E, as Einstein explained, equals mc^2. And that deceptively simple little equation explains why one gram of matter has an energy content equivalent to burning 9,500 litres of gasoline.

Energy equals mass times the speed of light multiplied by itself. That means even a tiny mass contains tremendous energy reserves waiting to be tapped.

And fusion technology, proponents say, is just the key to unlock the reserves.

According to the theory, if two tiny atomic nuclei could be forced to join together, they would produce a new nucleus that would be slightly lighter than the sum of the two parts.

The excess mass would be released as energy. The energy could be harnessed and used to light and heat our homes. The trouble is that nuclei, those tiny cores of atoms, have a strong repulsion for each other because they both carry positive charges. That means energy is needed to squeeze them together.

So far, the elusive goal of scientists is to reach the magical "breakeven" point, where more energy is created than is spent on fusing the nuclei.

Above the breakeven point, the reaction "sustains" itself. That means it creates enough energy to keep going on its own.

In experimental reactors such as the

Fusion (cont'd)

Tokamak in Varennes, Que., researchers invest electrical energy to press two hydrogen atoms together.

But according to contemporary fusion theory, the best fuel for a future commercial reactor is a half- and-half mixture of deuterium and tritium, two heavier forms of hydrogen.

Unlike the hydrogen nucleus, which contains one positive proton, deuterium has one proton and one uncharged neutron. It can be extracted from seawater and is not radioactive. Tritium, however, is radioactive. It contains one proton and two neutrons.

When deuterium and tritium fuse, with their total of five nuclear components, they produce a helium nucleus (two protons and two neutrons), a spare neutron and - most importantly - tremendous energy.

The new helium atom itself is energized, bouncing around and reinvesting some of its energy into continuing the fusion process.

When its energy is used up, it becomes a harmless waste product.

* Two types of reactors under development

  1. Magnetic confinement
     - Problems - ignition temperature
       - leakage of charged particles
       - energy input exceeds energy output.

  2. Tokamak reactor
     - Facts for operation
       *Temperature - 100 x 10^6 °C
       *Time - 1 second
       *Density - 10^{14} atomic particles per cm^3
       *Fuel - frozen pellet of deuterium-tritium (smaller than pin head)

* Goal - increase density of fuel pellet 10,000 times normal density of matter
  - pellet implodes in picoseconds (.10^9 sec.)

* Energy Released - 17.6 x $10^6{}_e$V (equivalent to few sticks of dynamite)

* Heat absorbs into lithium blanket producing heat.

GRADES 7-9

Sustainable Energy Issues

Mike Bergin
Ottawa Board of Education
56 Herridge St.
Ottawa, Ontario
Canada K1S 0G9
613-733-4860 (bus)
613-233-5051 (home)

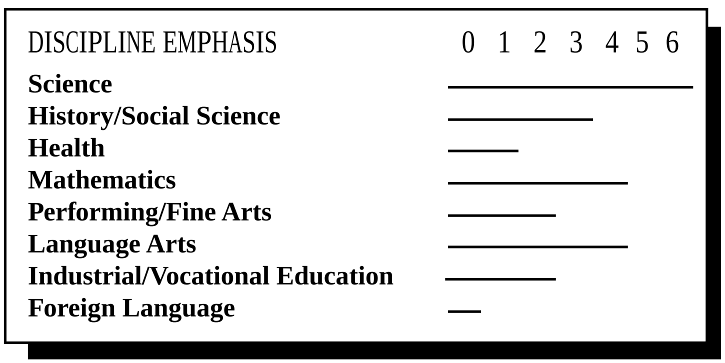
$20 per copy; 173 pages, 1992.

Grade 7

This core program incorporates family studies, art, music, drama, computers, and technology into core subject areas to present an integrated seventh grade unit.

REPORT CARD

Overall Grade	**A-**
General Content	**A-**
Presentation	**A-**
Pedagogy	**A**
Teacher Usability	**B+**
Energy Content	**A**



COMMENTS

General Content
Empowering to students. Puts activities in a context students can understand. Often presents both sides of an issue, usually given in context. Integrates across the disciplines.

Presentation
Fact sheets provide accurate, easily accessible information. Quality ditto pages including maps.

Pedagogy
Excellent scope of evaluation strategies. Some sections lack hands-on activities. Exhibits great diversity in instructional strategies. Addresses the affective and cognitive domains.

Teacher Usability
Describes cooperative learning strategies. Objectives not written to specific lessons. Teacher background is mingled with student sheets. Some sections available in French.

Energy Content
Covers many energy topics with some depth.

Geothermal Energy

For each active volcano there are probably hundreds of areas in which molten rock has pushed upwards to within a few kilometres of the surface of the Earth. I may take millions of years for such underground magma chambers to cool, for the solid rock that surrounds them also insulates them; rock is a very poor conductor of heat. What stores the heat in pockets and, thus turns a geological accident into a geothermal resource, is water. In tapping the Earth's heat, one is not mining rock, but water, and thus a convenient way to classify different kinds of geothermal resources is by "hotness" and "wetness".

1. Steam Reservoirs

Water permeating fissures and cracks in rocks which are heated to high temperatures (ranging around 235°C), may, depending on the pressure, turn to steam. If it does, and if this underground reservoir is sealed above by a lid of impermeable rock, it will become a kind of pressure cooker. The water will be pushed down by the pressure of the steam, so that if a hole is drilled through the lid, dry steam—under pressure and superheated—will escape. This dry steam is an excellent medium for driving steam turbines an, in turn, electrical generators. Reservoirs of dry steam, though, are rare. Only four are now exploited.

2. Hot water Reservoirs

Water heated up to high temperatures will not necessarily turn to steam if confined under high pressure. However, once this superheated water is exposed to air pressure, it will "flash", with a blast of noise. Less than a third of the water will actually vaporise. The majority will stay as a boiling hot liquid. This is a wet steam reservoir, the kind that is tapped for energy at most of the world's geothermal power plants. (Interestingly enough, lowering the pressure of a hot water reservoir in New Zealand turned it into a dry-steam field.)

3. Warm Water Reservoirs

When the temperature lies between 60°C and 140°C, as it does in the warm water near and under Reykjavik, electricity cannot be generated—not, at any rate, by means of conventional technology. But like an open pot used to warm rather than boil water, this kind of reservoir is tapped for heating.

4. Hot Dry Rocks

Concentrations of heat close to the surface are common not only in volcanic regions. Elsewhere, they may be due, among other causes, to locally high levels of radioactivity. But if the heated rocks are dry—either because they are solid, and thus hold no water, or because they have no underground supply of water—they are about as useful as a hot but empty kettle. To tap their heat, water must somehow be added, and to do this requires complex, and as yet imperfectly developed technology.

5. Sedimentary Reservoirs

In volcanic zones, heat flows are usually concentrated. In sedimentary basins, heat from diffuse flows is often accumulated and stored in the form of warm water, creating an entirely different kind of geothermal resource. For example, if the average temperature at a depth of 3 km is 75°C, and if it were covered by an insulating blanket of impermeable rock, then it would slowly collect heat until all its water has reached this temperature. In France, Hungary, the Soviet Union and other countries, warm water from sedimentary rocks is heating buildings and greenhouses. This kind of geothermal resource lies beneath much of the world's habitable land.

Exploring Energy #3, Geothermal Energy, S. McCutcheon, Ministry of Supply and Services pp.10-11.

An Experiment With Geothermal Energy

Problem:

- can steam produce mechanical energy?

Hypothesis:

- a jet of steam can turn a simple windmill.

Materials:

- heat-proof flask with a two-holed stopper
- eye dropper and bent glass tubing
- small block of metal
- small propeller
- bunsen burner or hot plate
- tongs, safety glasses, heat-proof gloves.

Procedure:

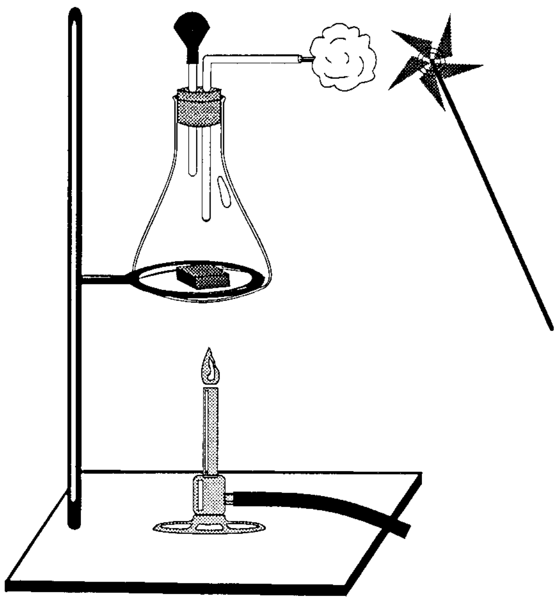
- put on the safety glasses and gloves.
- place the block of metal carefully in the bottom of the beaker using the tongs.
- set up a bunsen burner and heat the block of metal.
- arrange the stopper and glass tubing as shown in the diagram.
- place the propeller close to the end of the bent glass tubing.
- carefully allow water to drip onto the hot metal.

Observations:

- write down what happens.

Conclusions:

- how might the energy be used?



Global Energy Issues

Mike Bergin
Ottawa Board of Education
56 Herridge St.
Ottawa, Ontario
Canada K1S 0G9
613-733-4860 (bus)
613-233-5051 (home)

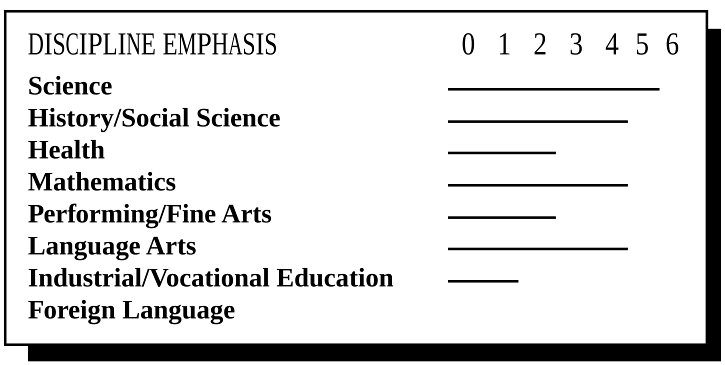
$20 per copy; 195 pages, 1992.

Grade 8

This curriculum provides opportunities for cooperative learning, independent study, and development of attitudes and values through strategies based on learner-centered instruction.

REPORT CARD

Overall Grade	**A-**
General Content	**A-**
Presentation	**B+**
Pedagogy	**A-**
Teacher Usability	**A-**
Energy Content	**A**



COMMENTS

General Content
Sound, integrated approach. Addresses the development of attitudes and values. Better for language arts, social studies, or math core.

Presentation
Seems to be fairly student centered. Energy issue fact sheets provide relevant information.

Pedagogy
Excellent evaluation section which includes authentic assessment. Good diversity in instructional strategies—small groups and independent work.

Teacher Usability
Items available in French. Outcomes at the start of each unit, not with each lesson. Includes teaching technique ideas. Good background information for teacher.

Energy Content
Comprehensive treatment of human energy issues.

Additional Evaluator Thoughts
The whole idea of these two units is great: it keeps kids active and motivated.

The House of the Future

Materials:

- Pictures of solar houses
- Art materials
- Cardboard
- Black hose or PVC tubing
- Black paint
- White glue
- Thermometer
- Aluminium foil
- Clear plastic wrap or clear acetate

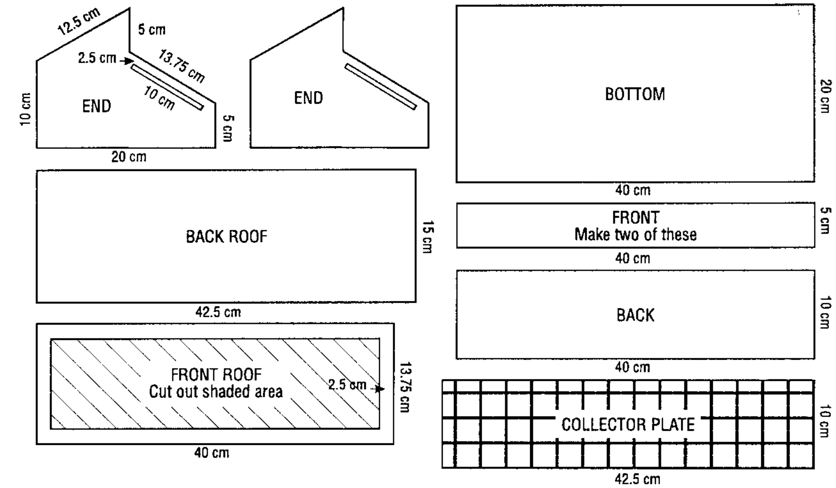
Procedure:

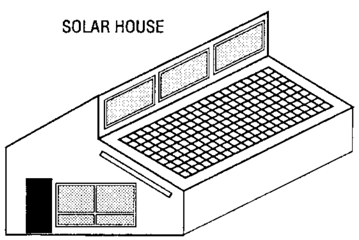
- Brainstorm as many methods of conserving energy in the home as possible (such as protected entrances, wind breaks, thermal windows, etc. ...)
- Decide which methods you'd like to use in a new house you are going to design and build. Find and bring in pictures of solar homes.
- You are going to draw, paint or create models of your solar home incorporating the energy conservation measures you have decided on—plus active and/or passive solar heating. You may wish to place the house in an energy-efficient landscape.
- If you'd like, you can build from the plans below:

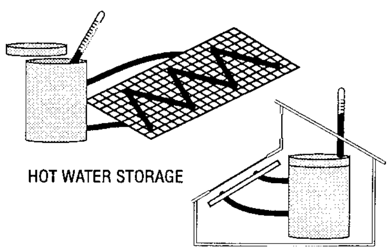
Plans for a Solar house:

- Transfer the plans on the following page onto strong cardboard.
- Cut out each of the pieces *carefully* using scissors or an X-acto knife.
- Assemble all the pieces except the collector plate, front roof and back roof using tape and white glue
- For greater insulation, double the thickness of all the walls and the roof.
- Cover the front roof section with plastic wrap or clear acetate.
- Cover the collector plate with aluminium foil and paint the foil with non-reflective black paint.
- Mount the collector plate inside the house through the slots cut 2.5 cm below the front roof.
- Fasten the front roof in place.
- Measure *inside* the walls where the back roof will be fitted and cut a piece of cardboard to fit inside this space. Glue this cardboard to the inside of the back roof to hold the roof in place. The roof must fit tightly to ensure heat doesn't escape.
- Paint the house and add windows and doors.
- Use a thermometer to record air temperatures inside the house.
- A solar storage tank can be created from an insulated cup (with lid) and copper or plastic pipe.
- Punch two holes for the pipe and one for the thermometer into the cup. You can put all the holes in the lid, but the pipe to the bottom of the collector must go down to the bottom of the cup and the other must be close to the top.
- Fill the can and the pipe with water. Be sure there are no air bubbles in the system.
- Take the temperature of the water right after you set the collector up. Record temperatures every 10 minutes afterwards.
- Create a display of your results.

Solar House Plans







GRADES 7-9

The California CLASS Project

California Department of Education
Bureau of Publications
P.O. Box 271
Sacramento, CA 95812-0271
916-445-1260/1-800-995-4099
916-323-0823 (fax)

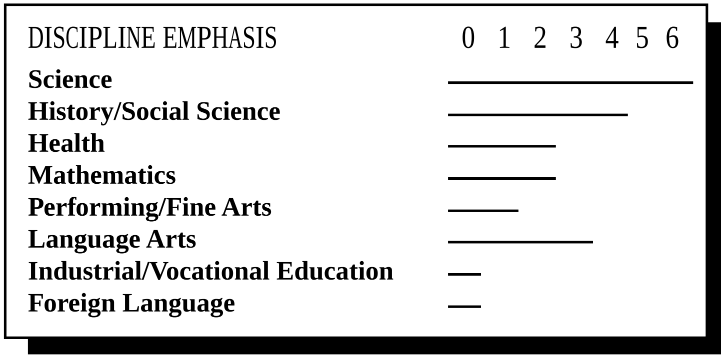
Item #9939, $29 plus tax, plus $4.95 shipping and handling; 373 pages, 1992.

Grades 7-9

This program is a series of 33 classroom-ready lessons presented in six thematic units.

REPORT CARD

Overall Grade	**A-**
General Content	**A-**
Presentation	**B+**
Pedagogy	**A-**
Teacher Usability	**A**
Energy Content	**B+**



COMMENTS

General Content
General overview to energy issues. Specific to California plants and animals.

Presentation
Highly organized curriculum with specific, easy to use activities. Good quality reproducibles. Lots of variety in the types of activities offered.

Pedagogy
Inquiry based and investigation oriented. Stresses reading with little or no hands-on involvement.

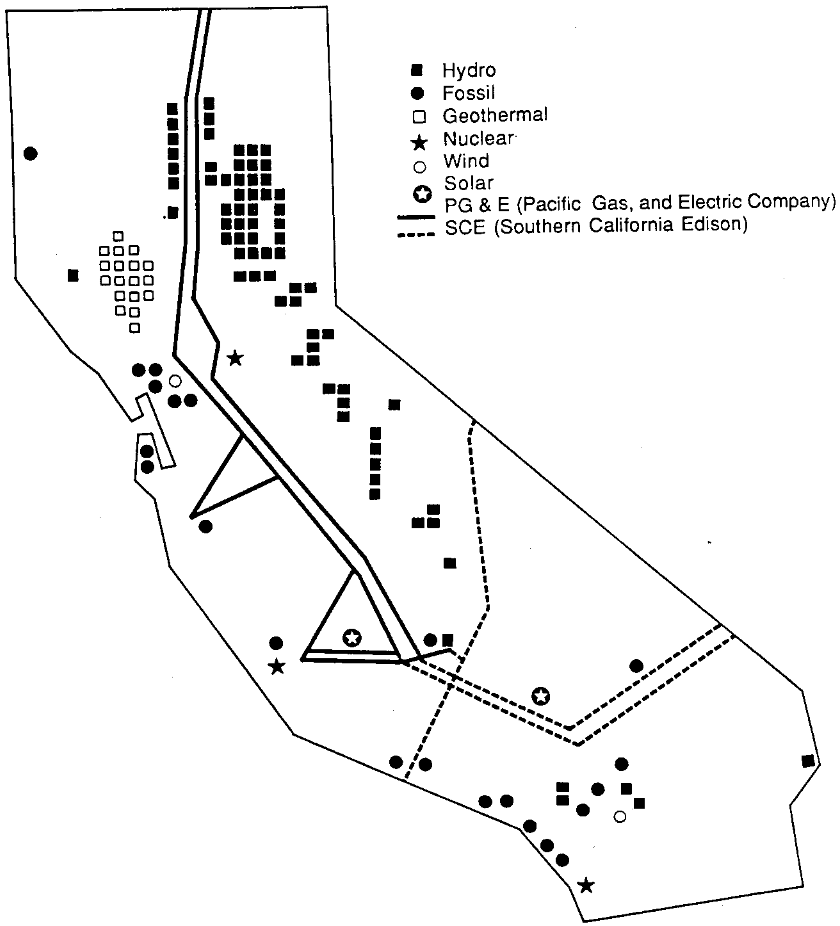
Teacher Usability
Includes California framework correlations. Well written, measurable objectives.

Energy Content
More an overall environmental curriculum with only a small percentage directly dedicated to energy resources. Covers transportation as an energy item.

Additional Evaluator Thoughts
Clearly a superlative, top-of-the line curriculum.

TRANSPARENCY C

MAP OF MAJOR ELECTRICAL GENERATING STATIONS IN CALIFORNIA



STUDENT WORKSHEET #1

POWER PUZZLE QUESTIONS

1. Near what city or town are your community's power plants located? ______________________

2. What company operates them? ______________________

3. What natural resources do the power plants use? ______________________

4. Are these resources renewable or nonrenewable? ______________________

5. Where does your electrical utility company get this resource? ______________________

6. What power plants are used for regular electrical base load? ______________________

7. From what source does the company acquire electricity during peak loads? ______________________

8. How does the electricity get from the power plant to your home? ______________________

9. List 2 benefits and 2 possible problems with your power plants. ______________________

10. What would be an ideal energy source for your community? Give reasons for your answers. ______________________

Issues, Evidence and You

Sargent-Welch
P.O. Box 5229
Buffalo Grove, IL 60089-5229
1-800-727-4368
1-800-676-2540 (fax)
http://www.sargentwelch.com

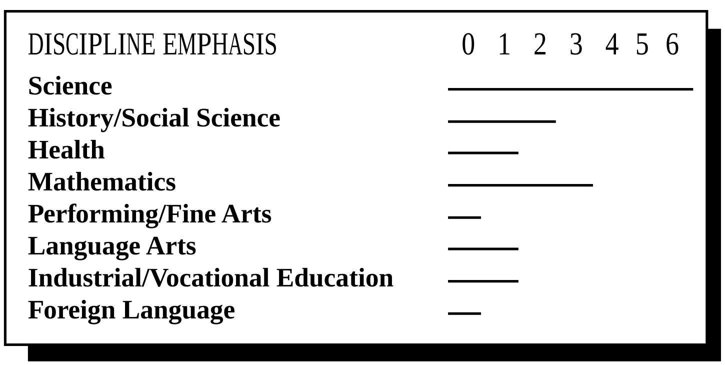
$4,028.99 (full year course which includes materials kit with equipment for five classes of 32 students, teacher's manual, and 32 sets of student books - replacement books available); 1995.

Grades 7-12. Evaluation based on review of materials for grades 7-9.

A diverse educational program highlighting science and its uses in the context of societal issues.

REPORT CARD

Overall Grade	**B+**
General Content	**A-**
Presentation	**B+**
Pedagogy	**A**
Teacher Usability	**A-**
Energy Content	**B**



COMMENTS

General Content
Complete with many unique, fun, relevant activities. Highly technical orientation for this grade level could provide sound basis for subsequent environmental education units.

Presentation
The large size of the notebook may turn teachers off this curriculum. Detailed teacher directions. Good photos and historical perspectives.

Pedagogy
Encourages students to use higher order thinking skills. Embedded assessment.

Teacher Usability
Small amounts of many things must be gathered for most labs. Time intensive.

Energy Content
Discusses the physics of electricity.

Introduction

Electrical Appliances: Then and Now Survey

By conducting this survey, you will collect data about the number of appliances you have in your home today, compared with the number of appliances your parents or guardians had at home when they were your age. The data will show any changes in the use of appliances and energy.

Challenge

Take a look at the appliances listed on the survey distributed by your teacher. Guess how many you have in your home right now. Now conduct the survey and find out!

Electrical Appliance Survey

Introduction

Electrical Appliances: Then and Now Survey

By conducting this survey, you will collect data about the number of appliances you have in your home today, compared with the number of appliances your parents or guardians had at home when they were your age. The data will show any changes in the use of appliances and energy.

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Take a look at the appliances listed on the survey distributed by your teacher. Guess how many you have in your home right now. Now conduct the survey and find out!

Activity 4[illegible]

Energy, Economics and the Environment—Middle School

Indiana Department of Education
Office of Program Development
Attn: Rose Sloan
Room 229, State House
Indianapolis, Indiana 46204-2798
317-232-9186
317-232-9121 (fax)

$8 per copy; 120 pages.

Grades 7-9

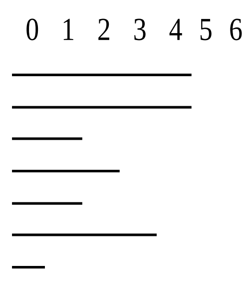
This curriculum provides a conceptual framework for analyzing energy and environmental issues, and provides teachers with a set of motivational, interdisciplinary teaching units centering on these important issues.

REPORT CARD

Overall Grade	**B+**
General Content	**A**
Presentation	**B+**
Pedagogy	**B+**
Teacher Usability	**B**
Energy Content	**B**

DISCIPLINE EMPHASIS

Science
History/Social Science
Health
Mathematics
Performing/Fine Arts
Language Arts
Industrial/Vocational Education
Foreign Language



COMMENTS

General Content
Relevant scenarios allow the decision-making process to flourish. Highly integrated; acknowledges the importance of economics.

Presentation
A good, challenging, thought-provoking approach--intriguing!

Pedagogy
Incorporates a decision-making model which empowers students. Encourages higher level thinking skills. Requires much independent work of students; many may need more direction.

Teacher Usability
Adequate background for teachers. Well written, measurable objectives.

Energy Content
Not necessarily energy intensive. Does not address renewable energy sources in depth.

The Case of the New Power Plant

Student Directions:

You are members of the city council in the growing community of Ourtown. You must evaluate several proposals for dealing with a growing shortage of electricity. After evaluating the arguments by each group, fill in the decision worksheet and grid, using the five step, decision-making process to decide which recommendation to accept.

Scenario:

Ourtown is enjoying a period of economic growth that most cities can only dream about. It has grown from a sleepy little rural town to a city with plenty of jobs and a high standard of living. Luckily, it has avoided the big-city problems with crime and pollution that plague many other communities during their boom periods. It has become a place people want to live and a place where businesses want to locate. As a result, the population has doubled during the past 20 years, yet, electricity is produced in a power plant built in 1947 for a much smaller population. During a heat wave last summer, so many air conditioners were turned on that power outages occurred all over town. The situation is expected to get worse in the future.

While sitting in the local barber shop waiting for a hair cut, Mr. Alvarez, President of the Ourtown Chamber of Commerce, complains loudly to everyone within earshot that without a new power plant, the city can forget about economic growth or even having sufficient capacity to meet residents' current needs. He argues that the cheapest way to meet the community's energy demand is by building a new coal-fired power plant.

The barber, Sally Friedman, responds that nuclear power would be more economical, particularly, if we take into account the environmental costs of both producing and using fossil fuels. "The safety record of nuclear power is better than that of other energy sources," states Ms. Friedman. "We have built so many fail-safe mechanisms into our nuclear plants that the odds against a major accident are astronomical." Mr. Alvarez counters that coal is our most plentiful energy resource, and that modern power plants can burn coal economically and in an environmentally responsible manner. Mr. Alvarez adds, "Even though the odds are heavily stacked against a major incident at a nuclear power plant, if it does happen, it will be catastrophic. Are we prepared to take that risk?"

Fred Simpson, who manages the local Dairy Queen, reminds the group that his restaurant is solar powered. "Why can't we use some of that vacant land just west of town to build giant solar collectors to generate power to meet the city's growing energy demand?" asks Fred. "This would be essentially free electricity from the sun waiting for us to take it. And unlike the case with nuclear power, we wouldn't have any disposal problem with dangerous radioactive waste."

Ben Johnson, who is active in several environmental groups, argues that people simply need to cut back, that their energy consumption is wastefully high. He points out that just setting our thermostats a few degrees higher in the summer and lower in the winter would save enough energy to avoid a shortage without the environmental cost of building new facilities for generating electricity. "Further," Mr. Johnson adds, "we don't need those ridiculously long hours of operation at the mall. Why don't we just require stores to reduce their hours of operation? Surely 12 hours per day is enough." Mr. Johnson reminds the others that any energy source involves some costs. For example, solar collectors are expensive to build, take a lot of valuable space that could be used for other purposes and produces energy only on sunny days.

Ms. Friedman responds, "Ben, that sounds great, but what about people whose health prevents them from setting back their thermostats? And how about my daughter and her friends, who would rather give up food and shelter than cut back on trips to the mall? How do we decide for other people which of the "needs" are more important?"

The discussion dies down without the group reaching a consensus.

Hot Water and Warm Homes from Sunlight

LHS GEMS
Lawrence Hall of Science
University of California
Berkeley, CA 94720-5200
510-642-7771
510-643-0309 (fax)
http://www.lhs.berkeley.edu

$13.50 each; 69 pages, 1995.

Grades 4-8

Students conduct straightforward, controlled experiments to find out how sunlight can best be used to heat houses and water.

REPORT CARD

Overall Grade	**B**
General Content	**B+**
Presentation	**B+**
Pedagogy	**B+**
Teacher Usability	**A-**
Energy Content	**C+**

DISCIPLINE EMPHASIS

0 1 2 3 4 5 6

Science
History/Social Science
Health
Mathematics
Performing/Fine Arts
Language Arts
Industrial/Vocational Education
Foreign Language

COMMENTS

General Content
Good projects, documentation, and discussion steps. Elementary solar energy experiments with detailed instructions for teacher.

Presentation
Reproducibles are clear and easy to follow. Good dittos to use as follow up or for demonstration.

Pedagogy
The curriculum actively solicits comments and criticisms in order to produce a more helpful model. Assessment is limited.

Teacher Usability
Summary outlines at the end of the curriculum provide quick reference. Includes a list of teacher's guides related to additional topics.

Energy Content
Practical development of several concepts related to solar energy applications.

ALAN'S COOKER

WHAT YOU NEED:

- ❒ 1 sheet of foilboard or other reflecting surface, 18" x 44" (46 cm x 12 cm) for the parabolic reflector
- ❒ 1 sheet of reflecting surface, 12" x 40" (30 cm x 100 cm) for the bottom reflector
- ❒ 1 sheet of cardboard, 12" x 40" (30 cm x 100 cm) for top reinforcing piece
- ❒ 1 push pin
- ❒ 1 pencil
- ❒ 1 scissors
- ❒ 16 paper fasteners
- ❒ 1 cooking vessel, such as one of the following:
  - — a dark-colored pot or pan with clear or dark lid
  - — a clear glass jar with clear or dark lid
  - — a clear Pyrex® pot with lid
- ❒ black metal supports for the cooking vessel; these can be empty tin cans painted black (small tomato sauce or tuna cans are about the right size)
- ❒ (*optional*) 2 edge sticks, ¼" x 12" dowels

Construction

1. Duplicate pages 46–49. With scissors, cut along the template lines. Tape the four template pieces together to make a single large template, as shown in Figure 1.
2. Using the template, mark a parabola on the top reinforcing piece and cut it to make the shape shown in Figure 2.
3. Draw two lines parallel to the long edges of the parabolic reflector, 1" (2.5 cm) from each edge. Cut slits in from the long edges to the line at 1" intervals as shown in Figure 3.
4. Fold the resulting tabs up. Line up the parabolic reflector to the parabolic curve on the top reinforcing piece. Tape the tabs to the top reinforcing piece to hold the parabolic reflector in place, as shown in Figure 4.
5. Punch small holes through a few of the tabs as close to the fold lines as possible. Make the holes go all the way through the top reinforcing piece. Use a push pin to punch the holes, then enlarge the holes with a pencil tip. Secure paper fasteners through the holes, as shown in Figure 5.

FIGURE 1

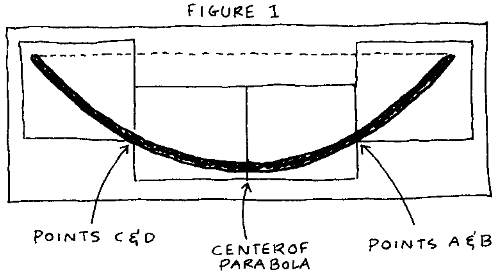


FIGURE 2

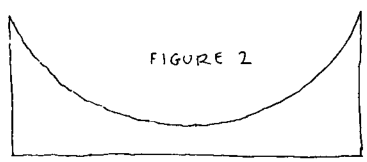
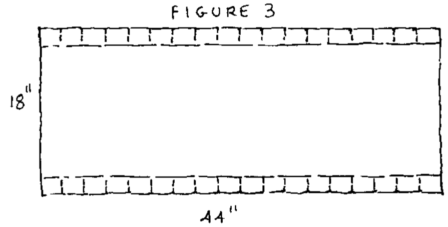


FIGURE 3



ALAN'S COOKER

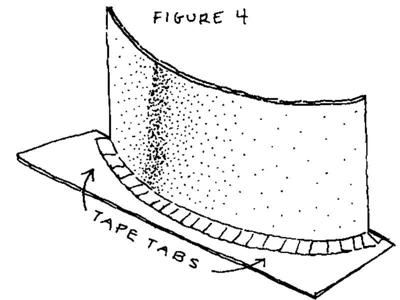
6. Lay the parabolic template on the bottom reflector and temporarily tape it in place. Lining up the parabolic reflector with the template, tape the tabs to the bottom reflector and secure with paper fasteners as in steps 4 and 5. Then remove the template.
7. (Optional) Tape edge sticks to each short edge of the parabolic reflector.

Note: To make a bigger cooker, make a larger template by plotting a number of "x" and "y" points according to the following formula for a parabola:

$$y = \frac{x^2}{4f}$$

(where "f" is the focal length, or distance from the parabola to the cooking vessel)

FIGURE 4



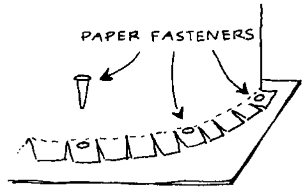
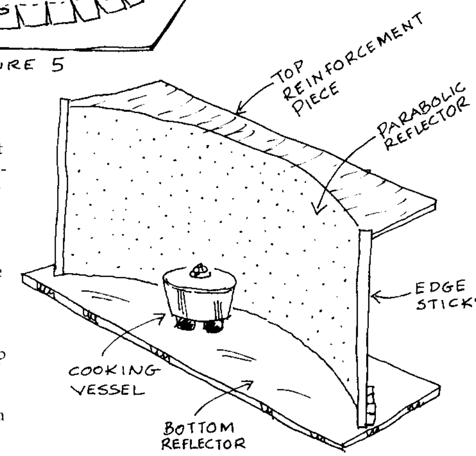


FIGURE 5

Using the Cooker

1. Orient the parabolic reflector so it faces the sun. On grassy or uneven ground, it is helpful to put the cooker on a wooden board. Put three identical blackened tin cans about 10" (25 cm) in front of the center of the parabolic reflector.
2. Put a cooking vessel containing food on top of the cans. It will start getting hot! You can make rice, steam vegetables, warm canned foods, boil hot dogs, and cook many other foods.
3. Move the cooker about every 15 minutes to keep it facing the sun.
4. Of course, the amount of time required to cook a particular food varies. A solar cooker can take up to twice as long as the same task would take on a standard stove.
5. The solar cooker can be disassembled for easy carrying and storage.



GRADES 7-9

Electric Vehicle Classroom Kit

EV Media
612 Colorado Ave., Suite 111
Santa Monica, CA 90401
310-394-3980
310-394-3539 (fax)

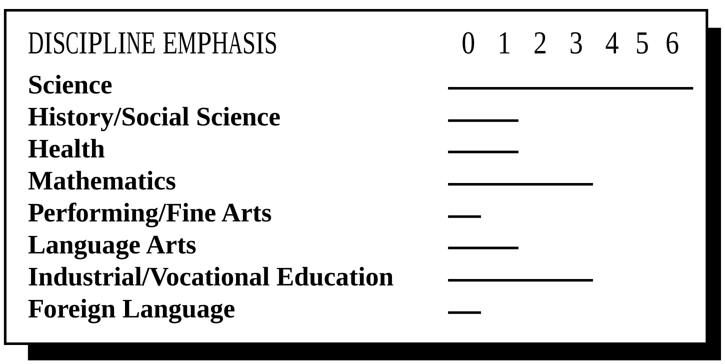
Kits start at $139.50 (121 page teacher book,
35 student booklets, and five model car kits); 1996.

Grades 7-12. Evaluation based on review of materials for grades 7-9.

The teacher’s book provides information and suggestions for conducting a unit; the unit is built around a sequence of activities, some of which are optional.

REPORT CARD

Overall Grade	**B**
General Content	**B+**
Presentation	**B**
Pedagogy	**A-**
Teacher Usability	**B**
Energy Content	**B-**



COMMENTS

General Content
Students discuss the integration of this one energy technology into society and may realize that issues are not clearly defined.

Presentation
Fun activity! Good pictures for junior high kids—good information in a current science format.

Pedagogy
Assessment tied to every lesson. Really addresses diversity among students.

Teacher Usability
Good background for teachers. Good teacher background materials. Excellent student materials.

Energy Content
Helps students analyze the problems of combustion engines and explore one possible solution.

Additional Evaluator Thoughts
Fun project — students would love to do this.

Dealing with the Dilemma

Overview

This lesson and the following one, which conclude the unit, are meant to help students relate what they have learned about electric vehicle technology to the urban air pollution problem and their analysis of their families' use of transportation.

Processes

Communicate.
Compare.
Relate.
Infer side effects of actions.

Objectives

Experience
✓ Grappling with a real, complicated problem that has no obvious solution.
Know
✓ Every action has side effects.
Are Able to Do
✓ Present a reasoned argument.

Assessment

Evaluate the student's answers to the worksheet and the quality and extent of participation on class *and team* discussion.

Conducting the lesson

Recall for the class how the unit began, with our need for transportation. But our transportation system produces air pollution.

Divide the class into teams, give each team a copy of the worksheet on the next page. After the team has discussed a question among themselves, each member of the team is to write his or her answer to the question on a separate sheet of paper. An individual's answer may agree with that of most of the other members of the team, or it may not. Depending on how the teams' progress and how well the discussions within the groups are going, you may want to allow the rest of the period for this activity.

When the teams have finished, hold a class discussion. Go through the questions, discussing each one and soliciting various views. It is sometimes helpful to ask, "Is there anyone who didn't agree with the other members of their team?"

Some points to consider in regard to the questions:

1. "No" is not necessarily a wrong answer.

2. Be sure the discussion doesn't only mention health effects. There are also economic effects (deterioration of materials) and indirect effects, such as loss of industries that prefer to locate in cleaner areas.

3. Students often say "everyone" is responsible, but don't leave it at that. It is equally true that "everyone" is responsible for traffic safety, but suppose only "everyone" were responsible. Would the roads be safe?

4. This question can be answered technically. What kind of data would be necessary and how could it be gathered?

5. When several "major advantages" or disadvantages are proposed, ask students to rank them.

11. Press students to go beyond describing their projects to explaining why they chose that project.

12. This question is one of philosophy.

13. Ask what other effects the measure would have that would not be related to air pollution.

What Do We Think?

1. Is air pollution a problem we need to do anything about? yes no
2. If urban air pollution gets worse, who will suffer?
3. Who is responsible for controlling urban air pollution?
4. Could electric cars help cities with an air pollution problem? yes no
5. Compare using electric cars with two or three other measures that would reduce urban air pollution. Name the major advantage and the major disadvantage for each measure.
6. Compare electric cars with gasoline-powered cars. What are some advantages and disadvantages of each?
7. Could an electric car meet the transportation needs of your family if it was your only car? yes no
   If it were a second car? yes no
8. What percentage of the members of your team think an electric car would do as a first or second car for their family?
9. Make a prediction. Will city dwellers buy many electric cars in the next five years? Why?
10. To increase the appeal of electric cars to buyers, what characteristics of electric cars would benefit the most from improvement? Price range weight styling availability of cars availability of chargers
11. If you were in charge of a large budget to be spent on improving electric cars, what projects would you finance?
12. Should governments promote the use of electric vehicles? yes no

If they should, which (if any) of the following actions should they take (check any that apply)

❑ force manufacturers to build electric cars
❑ special parking privileges for electric vehicles
❑ reduced tolls on bridges and toll roads
❑ require garages in new homes be wired for a charger
❑ allow electric cars to use car pool lanes on freeways
❑ tax credits or reduced registration fees

13. What method or methods of reducing urban air pollution do you personally prefer, and why?

Geothermal Energy

Geothermal Education Office
664 Hilary Drive
Tiburon, CA 94920
415-435-4574 /1-800-866-4436
415-435-7737 (fax)
http://www.geothermal.marin.org

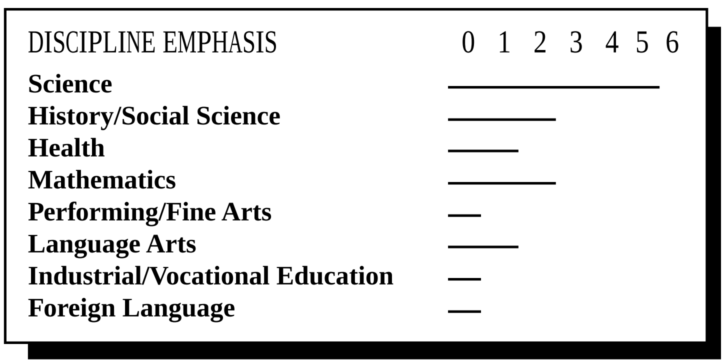
$8 per curriculm (includes shipping and handling), New video: Geothermal Energy: A Renewal Option now available with free lesson plans. Free classroom materials. Speakers can also be arranged.

Grades 4-8

This unit describes geothermal energy in the context of the world's energy needs, addressing renewable and nonrenewable energy sources with an in-depth study of geothermal energy.

REPORT CARD

Overall Grade	**B**
General Content	**B+**
Presentation	**B**
Pedagogy	**B**
Teacher Usability	**B**
Energy Content	**B**



COMMENTS

General Content
Great graphics joined with simple lessons which develop the subject of geothermal energy. Seems somewhat elementary for 7th through 9th grade students.

Presentation
Great diagrams. elementary video—probably the cartoon part would be insulting to older kids, but the diagrams and information are good.

Pedagogy
Students are encouraged to work together in groups. No formal assessment.

Teacher Usability
Highly organized with a specific teacher instruction section. Useful for individuals with a limited science background. States specific framework correlations within curriculum.

Energy Content
Great job on thoroughly exploring geothermal energy and it's uses.

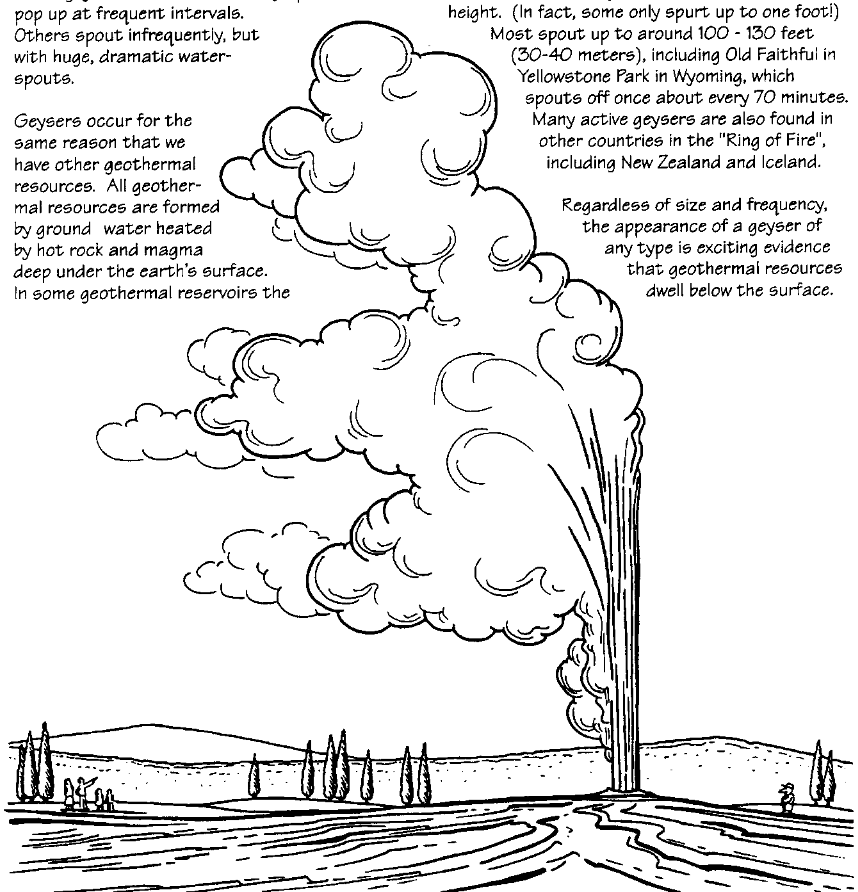
WHAT IS A GEYSER?

Scalding hot water and steam suddenly gush out of the earth. What is this strange apparition? It's a natural geothermal hot water fountain called a geyser. The name comes from the Icelandic word, "Geysir," meaning "gusher". Some geysers send up their spouts regularly, every few minutes, hours or days. Others are very irregular. Some geysers have small, bubbly spouts which pop up at frequent intervals. Others spout infrequently, but with huge, dramatic waterspouts.

Geysers occur for the same reason that we have other geothermal resources. All geothermal resources are formed by ground water heated by hot rock and magma deep under the earth's surface. In some geothermal reservoirs the pressure builds until it has to be released. So hot water and steam whoosh up through weak areas in the rock to the surface, making a hot water and steam fountain.

Some geysers have been known to shoot as high as 1,500 feet (460 meters), such as one found in New Zealand. Most geysers never reach this height. (In fact, some only spurt up to one foot!) Most spout up to around 100 - 130 feet (30-40 meters), including Old Faithful in Yellowstone Park in Wyoming, which spouts off once about every 70 minutes. Many active geysers are also found in other countries in the "Ring of Fire", including New Zealand and Iceland.

Regardless of size and frequency, the appearance of a geyser of any type is exciting evidence that geothermal resources dwell below the surface.



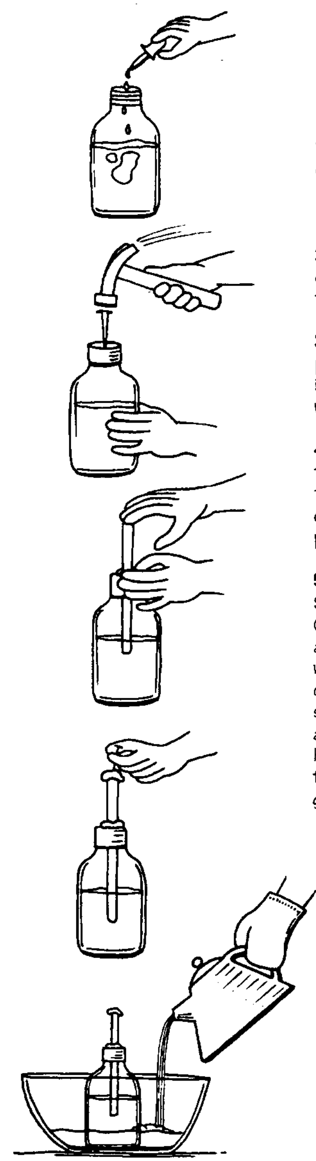
MAKE YOUR OWN GEYSER

In this experiment you will create your own "geyser" using some of the same forces that cause "real" geysers.

Geysers are the result of hot water and steam building up great pressure under the earth's surface. When the heat and pressure are great enough, the water expands (producing steam) and pushes the hot water in a gush up through weak spots and cracks in the earth's surface.

Materials
(Per group of students):

- bowl
- small strong bottle with a screw cap (preferably glass)
- modeling clay
- straw
- pin
- some food coloring or ink
- large nail & hammer
- a method to heat water
- hot mitts
- goggles, if possible
- water



Directions:

1.) Make a hole in the bottle's cap using the nail and hammer. Heat up water so that it will be boiling when you need it.

2.) Half fill the small bottle with cool water. Add a few drops of the ink or food coloring.

3.) Screw on the cap tightly and push the straw through the hole in the cap. Seal the hole well with clay.

4.) Stuff a small piece of clay in the top of the straw. Make a tiny hole all the way through the clay with the pin. Remove the pin.

5.) Pour hot water into the bowl. Stand the bottle in the bowl. Observe what happens. As the air inside the small bottle warms up, it will push the colored water up and out of the straw. This is because the air and water expand when they are heated and spread out, just as the steam expands underground.

GRADES 7-9

Energizing Your Future with Energy, Economics and the Environment

National 4-H Council
National 4-H Supply Service
c/o Cresstar Bank
P.O. Box 79126
Baltimore, MD 21279-0126
301-961-2934
301-961-2937 (fax)

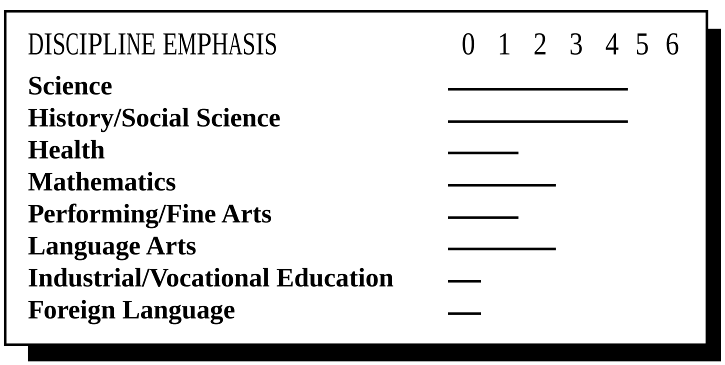
Item #ES1009, $5 per copy; 1996.

Grades K-12. Based on review of materials for grades 7-9.

This guide contains five chapters, each focusing on a different topic related to the interrelationships between energy, economics, and the environment.

REPORT CARD

Overall Grade	**B**
General Content	**B+**
Presentation	**B-**
Pedagogy	**B-**
Teacher Usability	**B-**
Energy Content	**B**



COMMENTS

General Content
Helps students see the economics of energy use—supply and demand. Some project ideas.

Presentation
Has some interesting approaches and perspectives. No student materials, just teacher materials.

Pedagogy
Requires higher level thinking skills and application of concepts. No assessment activities.

Teacher Usability
Some extensions seemed more appropriate than the discussion lessons. Includes a developmental characteristics section and a chapter activity matrix.

Activity 3.2
Auctioning Energy

Ages: 9 to 18
Style: adult or teen led
Life Skills: disagreeing and refusing, expressing an opinion, observing and listening, asking questions to get information, comparing and selecting alternatives, managing resources to achieve a goal
Pre-Activities: 1.1, 2.1, 2.2, 2.3, 2.4, 2.5, 3.1
Time Needed: 30 minutes
Group Size: any
Indoors or Outdoors: either
Materials Needed: copies of Activity Sheet 3.2A cut apart; different types of wrapped candies

Activity Goals
To demonstrate how natural resources such as energy are subject to the laws of supply and demand.

Preview
Participants play a game illustrating how supply and demand affect energy prices.

How to Do the Activity
Explain that prices help people decide what to buy, what to make, and what to sell. But how do you think prices are set? (Ask participants to give ideas.)

Prices are influenced by the *law of supply and demand*. As the price of bicycles goes down, more people want to buy them. But as the prices go down, fewer people want to sell them. So the prices may rise because the supply is influenced. As the price of bicycles go up, more people want to make and sell them, but fewer people want to buy them. In the American marketplace, the demand and supply match up fairly closely.

To demonstrate supply and demand, play the following game with the group. Give one participant a handful of candies representing a supply of an energy source (coal, oil, wood, etc.). This person will be the "Energy Auctioneer." In this situation, there is a limited supply of energy (one handful) for the entire group.

Give each person in the rest of the group 10 "dollars" from Activity Sheet 3.2A. Have the Energy Auctioneer ask people to place bids for the handful of candies. Start the bidding with one dollar. Caution participants that they will be bidding on several rounds of candies, so they probably don't want to spend all their money right away. Each round of candies may be different.

Talk about what is happening as the auction continues. Notice that as the price increases, fewer and fewer people bid (i.e., price increases, demand decreases). At some point the price gets so high that most people don't feel it's worth buying the product. Give the handful of candies to the highest bidder.

As a real-life example, note that in the 1970s the supply of oil in the United States (and other countries) was restricted by oil-producing nations. This caused prices to rise. Eventually prices got so high that people began to find ways to use less oil (lower the demand). They purchased more gas-efficient cars and conserved energy in their homes.

In the next round of the game, something new happens. Other people want to make money too, so

they decide to start selling candies. Give four people each a handful of candies different from each other. Now each of these four is an Energy Auctioneer. The supply of energy resources is much larger now.

Start the bidding process again at one dollar. Have all four Energy Auctioneers try to "sell" their energy resources at the same time. What happens? As the supply increases (assuming demand is the same), prices fall.

Ask the group: Suppose only one Energy Auctioneer can sell energy resources. What would happen? (The price would rise. This is called a monopoly. The U.S. government regulates industries to discourage monopolies.) What if another energy source (for example, solar) became available? (It depends on the price of the solar energy--if it is less than the prices of existing sources of energy, people would buy it.) What would happen to the demand for the first energy source? (It would generally go down. However, it might stay stable or even increase, if more industries and businesses were started as a result of lower energy prices.)

Share the following illustration with participants by redrawing it on a chalkboard or flip chart. This will help summarize the basics of energy economics.

Illustration CC

Evaluating Progress
Explain how the laws of supply and demand would affect the price of a favorite product (football, CD, perfume). What would happen to the price if demand increased? (Generally, it would go up.) Decreased? (Generally, it would go down.) What would happen to the price if supply increased? (Generally, it would go down.) Decreased? (Generally, it would go up.)

Fair Game
Research and report on a time in history and how energy sources were affected by supply and demand (e.g., the energy crisis of the 1970s). Show how supply and demand affected energy prices and the effect that had on people's lives.

All for One and One for All
Help residents in your community who have difficulty paying for energy by offering to weather strip their homes or provide other energy saving work. Your local utilities might have similar programs already in place that you can volunteer for. Be sure to evaluate as best you can whether your action saves energy. Ask yourself: if we replace the light bulbs in a den with low wattage ones, will people just use more lamps to do the same jobs? If we help people block drafts at the bottoms of their doors, are we using materials that provide a good return, since it took energy to make the products in the first place? Think about it, and help educate people about using energy and other resources wisely.

Learning to be Water Wise and Energy Efficient

Learning to be Water Wise and Energy Efficient
Program Fulfillment Center
2351 Tenaya Drive
Modesto, CA 95354
888-438-9473
209-529-0266 (fax)
http://www.getwise.org

$25-40 per student (includes four components which may be purchased separately: water, light, comfort, CD rom game); 1995.

Grades 4-8

This program involves students in activities that, when concluded, will result in their learning ways to consume less water and energy.

REPORT CARD

Overall Grade	**B**
General Content	**B**
Presentation	**B**
Pedagogy	**B-**
Teacher Usability	**B**

DISCIPLINE EMPHASIS 0 1 2 3 4 5 6

Energy Content **B-**

Science
History/Social Science
Health
Mathematics
Performing/Fine Arts
Language Arts
Industrial/Vocational Education
Foreign Language

COMMENTS

General Content
Involves parents and kids with school and community goals. Many great energy saving ideas which are easy to do.

Presentation
Provides samples of water conservation equipment. Good posters on the water cycle and electrical generation.

Pedagogy
There are no objectives provided. Discussion questions do not encourage use of higher order thinking skills.

Teacher Usability
Background information for the teacher is limited.

HIGH EFFICIENCY SHOWERS ARE A BLAST!

Activity Three

The last time you took a shower, you used about 28 gallons of water. Twenty-eight gallons of water went down the drain, just so you could wash your body, and maybe your hair.

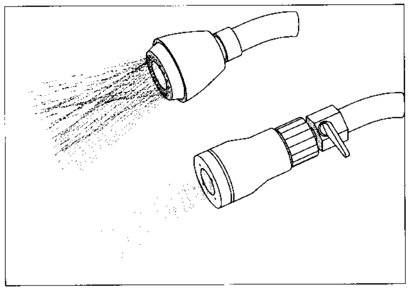
So what? We have lots of water, right? Wrong! Water is a limited resource. That means we don't always have enough of it to go around. Since people cannot live without water, we need to learn how to keep from wasting it.

Find the Correct Answer:

What is the simplest way to reduce the amount of water your family uses in the shower each year?

- **a.** Take fewer showers.
- **b.** Take shorter showers.
- **c.** Replace your standard showerhead with a high efficiency showerhead.

If you answered "a" or "b," you are close but not correct. The question asked for the "simplest" way to reduce shower water. You save water by cutting back on your time in the shower. But you have to change the way you do things. When you use a high efficiency showerhead—answer "c"—you spend the same amount of time in the shower. And you still save water.



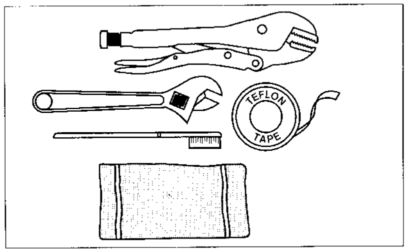
Compare the water flow of the regular showerhead (top) and the high efficiency showerhead (bottom).

High efficiency showerheads all have one thing in common: they use less water. A family of four, for example, can save nearly 34,500 gallons of water and almost $280 each year just by switching showerheads.

How to Make the Switch

1. **Talk to your parents first.** Show them the new high efficiency showerhead. Tell them they will save water, energy and money by using one. Promise them that the new shower will feel just as good as the old.

2. To install the new showerhead, follow the instructions provided. **Your parents will need:**



- Vise grip pliers
- Crescent wrench
- Old toothbrush
- Teflon tape
- Cloth

3. It might be helpful if you read the directions to them.

4. Grip the shower arm about one inch above the showerhead attachment nut with vise grip pliers.

5. Hold the vise grip pliers in place. Using a crescent wrench, turn the showerhead attachment nut slowly in a counterclockwise direction. Remove the old showerhead.

6. Flush out the shower pipe by turning on the water and running it for five seconds.

7. Clean threaded area of shower arm with an old toothbrush.

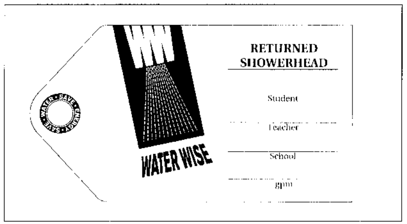
8. Wrap teflon tape three times clockwise around threaded tip of shower arm.

9. Screw the high efficiency showerhead onto the taped part of the shower arm. Place cloth inside the crescent wrench grip area and tighten slightly. Now, you can enjoy your shower while consuming less water and the energy it takes to heat the water!

Note:

Please Return the Old Showerhead

Your sponsoring utility wants to know that you and your family installed your new high efficiency showerhead. Therefore, you are asked to use the identification sticker included in your kit. Fill out the information requested on the sticker, affix it to the old showerhead, and return it to school. Place it in the container provided for this purpose in your classroom.



Identification sticker. Attach to your old showerhead.

BONUS ACTIVITY

If your sponsor is not collecting the old showerheads, how might your class use them to demonstrate to the community what you have been doing to conserve water and energy? Let students brainstorm possibilities.

BONUS ACTIVITY

Can you solve this puzzler after reading all the facts below?
(Hint: Some of the facts simply provide information; others give clues to help you solve the problem.)

Puzzler:
Rufus Richmond takes one shower a day. His very messy son, Ralph, takes a bath every night before he goes to bed. Rufus' wife, Rita, prefers to shower every other day. About how much water do the Richmonds use to keep themselves clean each year?

Facts:

- **Most Americans take one shower each day.**
- **The average person showers for 7.5 minutes.**
- **The average shower releases about four to six gallons of water each minute.**
- **About 66 percent of the water needed for a warm shower must be heated.**
- **People who take baths use 30-40 (35 average) gallons of water with each bath.**

Answer:
Rufus takes one shower a day for 7.5 minutes each time. Since Rufus is not using a high efficiency shower head, he uses 4 gallons of water each minute; 7.5 x 4 = 30 gallons per day [30 x 365 = 10,950]. Rufus uses 10,950 gallons of water per year. Ralph uses 35 gallons of water per day [35 x 365 = 12,775]. Ralph uses 12,775 gallons of water each year. Rita takes exactly half the amount of showers that Rufus takes [10,950 divided by 2 = 5,475]. Rita uses 5,475 gallons of water each year. Add 10,950 to 12,775 and 5,475 and you get the solution. The Richmond family uses 29,200 gallons of water each year to keep clean.

Environmental Science Activities Kit

Prentice Hall
Order Processing Department
P.O. Box 11071
Des Moines, Iowa 50336
515-284-6751
515-284-2607 (fax)
http://www.phdirect.com/phdirect

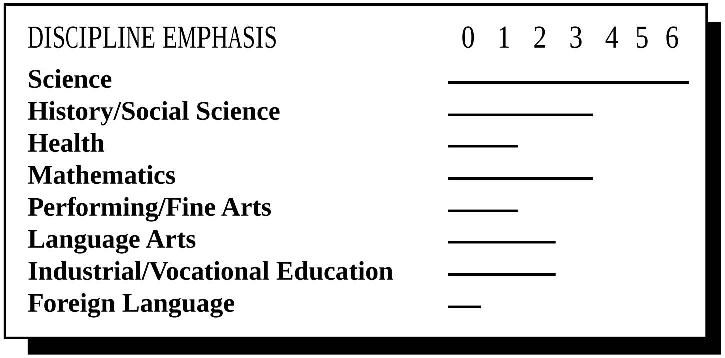
$29.95 each; 332 pages, 1993.

Grades 7-12. Evaluation based on review of materials for grades 10-12.

Thirty-two interdisciplinary science lessons organized into six topical units focusing on major environmental issues.

REPORT CARD

Overall Grade	**A-**
General Content	**A-**
Presentation	**A-**
Pedagogy	**B+**
Teacher Usability	**A**
Energy Content	**A-**



COMMENTS

General Content
Good for physical science/environmental science students. May not be truly challenging for advanced high school students.

Presentation
Student materials for reproduction are nicely designed and easy to use.

Pedagogy
A wealth of student activities with many alternative strategies and learning extension opportunities.

Teacher Usability
Materials are easy to obtain at no or low cost. Easy to integrate into individual student projects. Great reference for activities that emphasize ideas.

Name ______________________ Class __________ Date __________

22.2 Fossil Fuel Extraction: Instructions and Data

Your teacher will provide you with a cookie. This cookie represents a land area that may contain deposits of coal (represented by raisins), oil (represented by pieces of nuts), and/or natural gas (represented by chocolate pieces). You will also be provided with a toothpick, which represents the mining and drilling equipment used in obtaining the coal, oil, and natural gas.

Your job is to try to remove as much of the coal, oil, and natural gas as possible with as little damage to the environment as possible.

Imagine that the top surface of the original cookie is an area of land on which various kinds of plants and animals live.

In the space below, sketch the cookie surface before and after "mining."

Also, record the amounts of the various resources that you were able to obtain and the amount of "waste" generated. (**Estimate:** about _______% of the original cookie.)

BEFORE MINING **AFTER MINING**

resources recovered (as % of the original cookie):

_____% coal (raisins) _____ % natural gas (chocolate)

_____ % oil (nut pieces) _____ % waste (crumbs and pieces)

Name ______________________ Class __________ Date __________

22.3 Fossil Fuel Extraction: Questions

1. What are some problems associated with obtaining and using coal?
2. What can be done to reduce or avoid these problems?
3. What are some problems associated with obtaining and using oil?
4. What can be done to reduce or avoid these problems?
5. How can saving electricity help reduce the need for mining and shipping coal?
6. List some ways that you could reduce your electricity use.
7. How can reducing gasoline consumption reduce the need for mining, shipping, and refining oil?
8. List some ways that you could reduce the need for oil?
9. What are some advantages and disadvantages of natural gas as an energy source?

The Energy Sourcebook—High School Unit

TVA Environmental Research Center
P.O. Box 1010, CTR 2C
Muscle Shoals, AL 35662-1010
205-386-2714
205-386-2126 (fax)

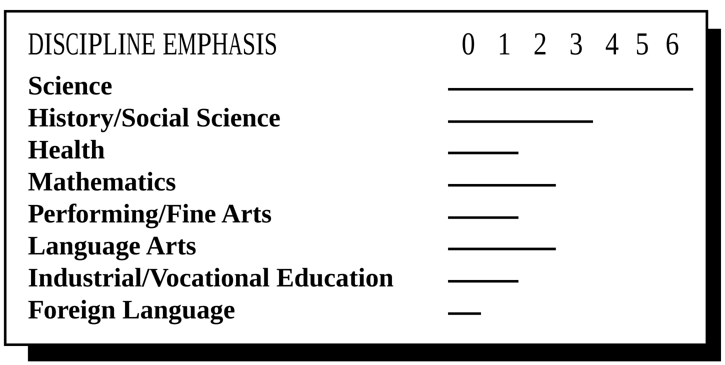
$35 each; 1990.

Grades 10-12

The “Sourcebook” is intended to aid teachers in teaching not only basic science concepts, but real-life application of these concepts in energy studies.

REPORT CARD

Overall Grade	**A-**
General Content	**A-**
Presentation	**B+**
Pedagogy	**A-**
Teacher Usability	**A-**
Energy Content	**A-**



COMMENTS

General Content
There is good integration of earth, life and physical science. Interdisciplinary in scope.

Presentation
Black line masters for transparencies and student activities are good. Needs to update some energy graphs (some date to 1977).

Pedagogy
Good hands-on activities and simulations.

Teacher Usability
Some of the chemicals used in these activities are not allowed in California schools (i.e. Carnog’s fixative with chloroform). Includes a complete reference list for each section.

Energy Content
Explains basic energy concepts with simple demonstrations.

Additional Evaluator Thoughts
Highly recommended for environmental education or energy component of any science curriculum.

ALCOHOL AS AN ALTERNATIVE FUEL

OBJECTIVES

The student will do the following:

1. Produce alcohol by the fermentation of a plant product.
2. Compare the burning characteristics of alcohol to those of kerosene or other petroleum products.

SUBJECTS:
Chemistry, General Science

TIME:
3 class periods

MATERIALS:
bottles or other narrow-necked containers, molasses, yeast, cotton plugs (for bottles), cardboard box, lamp with 40-watt bulb, distillation apparatus, evaporating dish, matches, kerosene, student sheet (included)

BACKGROUND INFORMATION

Alcohols are a group of compounds that consist of carbon, hydrogen, and oxygen. They can be used as clean, renewable fuels for cars and homes. Two members of this group are methanol or wood alcohol (CH_3OH) and ethanol or grain alcohol(CH_3CH_2OH). Methanol is poisonous if taken internally but is widely used as "dri-gas" and windshield cleaner. Ethanol is found in alcoholic beverages and is used in some medicines. 2-Propanol or isopropyl alcohol ($CH_3CHOHCH_3$) is used as rubbing alcohol.

Alcohols have long been used as fuels for fondue pots, in campstoves, and in survival kits because they burn cleanly and are portable. Some alcohols are used as fuel for auto racing because they give superior performances in some racing engines (compared with using gasoline). Alcohol mixed with gasoline in a proportion of 10 percent ethanol to 90 percent gasoline can be burned in most automobiles without modification. This blend is called gasohol. (The use of gasohol might damage fuel line seals in some automobiles; before using blended fuels, check the owner's manual.)

There are several reasons for considering the use of alcohols as fuels. Plant materials (a kind of biomass) can be used to produce these alcohols, especially ethanol. Biomass is a renewable resource, whereas our rapidly vanishing petroleum resources are nonrenewable. Biomass resources suitable for alcohol production are readily available in the United States, including the Tennessee Valley, and could help reduce our dependency on imported fuels. The technology for alcohol production from grains is well known and can be implemented easily.

Ethanol is produced from materials whose carbohydrate content can be fermented. Various grains, sugar-producing crops, and potatoes and other starchy plants are commonly used to make ethanol. Fermentation of these materials yields a very weak alcohol solution that must be distilled to a usable concentration; adequate concentration is usually above 95 percent ethanol. Grain contains both proteins and carbohydrates. One bushel of corn (56 pounds) will produce 2.6 gallons of 100 percent (anhydrous) ethanol, as well as 17 pounds of distilled dried grain (protein) which can be fed to livestock. Sugary substances, such as molasses, contain only carbohydrates, and are easily converted by fermentation into ethanol.

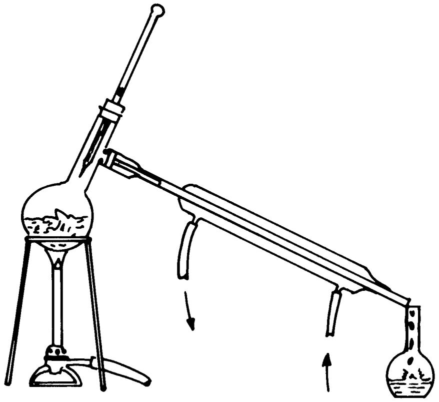
PROCEDURE

I. Share the "Background Information" with the students. Tell them they will be fermenting sugar to produce alcohol.

II. Give each student a copy of the student sheet (included). Divide them into groups of three students each. Distribute the bottles, cotton plugs, molasses, and yeast to the groups. Make the cardboard box and the lamp available.

III. Have the students prepare their fermentation mixtures according to the directions on the student sheet, placing their bottles in the box for overnight fermentation.

IV. The next day, assemble the distillation apparatus (as shown in the diagram) and distill the alcohol from the combined mixtures.



A. Have the students measure and record the temperature within the flask on the chart on the student sheet.

B. Distill 20-30 ml of clear liquid; then remove the heat and stop distilling.

V. Compare the burning of the distillate and a petroleum product.

A. Place the distillate in an evaporating dish and try to ignite it. If it burns, have the students write a few sentences about the color of the flame, any odor, and whatever residue or ash that remains.

B. Ignite a small sample of kerosene or other petroleum product in the same manner as the distillate. Have the students write down their observations about the burning kerosene. Ask them which might make the best fuel—the distillate or the kerosene? Why?

C. Demonstrate the miscibility of alcohol and water. Ask the students how the miscibility of alcohol and water might pose problems in using alcohol as a fuel.

VI. Continue with the follow-up below.

GRADES 10-12

Renewables Are Ready: A Guide to Teaching Renewable Energy in Jr and Sr High School Classrooms

Union of Concerned Scientists
Publications Unit
Two Brattle Square
P.O. Box 9105
Cambridge, MA 02238-9105
617-547-5552
617-864-9405 (fax)
http://www.ucsusa.org

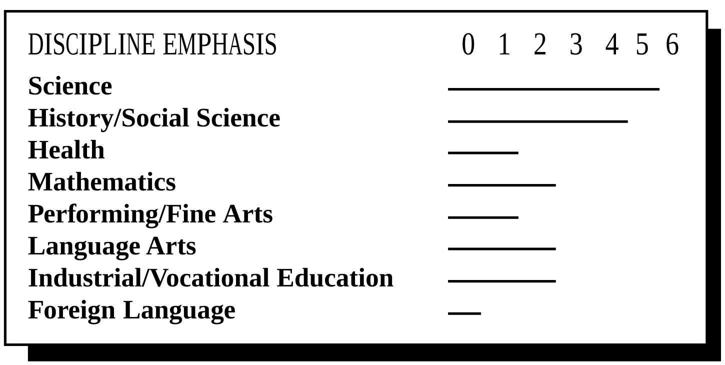
$5 for single copies, $3 each for orders of 10 or more. Add 20% for shipping and handling. 101 pages, 1994.

Grades 7-12. Evaluation based on review of materials for grades 10-12.

This guide is intended to help teachers introduce students to renewable energy technologies and to the political and economic conditions necessary for their implementation.

REPORT CARD

Overall Grade	**A-**
General Content	**B+**
Presentation	**B+**
Pedagogy	**A-**
Teacher Usability	**A**
Energy Content	**A-**



COMMENTS

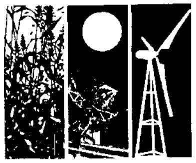
General Content
Good selection of activities to support the teaching of renewable energy sources.

Presentation
There are some great ideas here.

Pedagogy
Contains several student-centered activities using a constructivist approach to enhance student understanding. Very hands on, minds on.

Teacher Usability
Safety needs to be beefed up — "Be careful not to burn yourself (on the Bunsen burner)" is inadequate. Annotated resource guide included.

Energy Content
Information on the sources of renewable resources are thorough.



Biomass

Biomass is organic material--material from plants or animals--that can be burned to produce heat or can be converted into liquid or gaseous fuels. This experiment shows students how to produce a burnable gas by destructive distillation, or pyrolysis, of biomass.

Biomass combustion does produce carbon dioxide, a greenhouse gas. However, if all land used to grow biomass is replanted, there is no net addition of carbon dioxide to the atmosphere.

Before 1900, biomass--in the form of wood--was the United States' main energy source, but today it provides only 4-5% of the nation's primary energy needs. It could supply more. Using waste for biomass is especially promising. Crop and animal wastes or organic municipal wastes can be burned or converted into fuels instead of being dumped in landfills. Methane is collected from some landfills and burned for energy, and ethanol from grain surpluses is converted into a gasoline additive in some parts of the country. There is also considerable potential for growing biomass energy crops for thermal energy or fuel.

Converting biomass to liquid or gaseous "biofuels" is convenient for fueling vehicles. Gasification, pyrolysis, and fermentation are some of the processes that can turn biomass into fuels such as syngas, methanol, or ethanol.

GRADES: 10-12

TIME: one class period (45 minutes)

SUBJECT: science (chemistry)

MATERIALS: Divide the class into groups of 2-4. Each group needs:

- biomass source--small wood chips are suggested (you could use cut-up splints)
- large test tube and test tube holder
- Bunsen burner
- rubber stopper with one hole
- glass tubing that fits snugly in stopper hole
- wood splint
- mass balance
- safety glasses

CAUTIONARY NOTE: The gas produced in this experiment can be explosive under pressure. Close supervision is recommended. Students should wear safety glasses. Be careful that students are not burned by the burner or splint flame. Provide adequate ventilation; make sure the test tubes are vented as illustrated in the diagram.

PROCEDURE:

1. Ask students if they know what biomass is. See if they can name some kinds of biomass. Ask them to think of ways biomass can supply human energy needs.
2. Describe to them different kinds of biomass. Show how they are used as energy sources in the world today. Describe what biofuels are and how they are created and used.
3. Perform the experiment. Explain the directions carefully beforehand; distribute the directions as a handout. Supervise the students closely; for safety reasons, you may want to divide the class into groups of a size that is most easily managed.

FOLLOW-UP:

1. Ask students to draw conclusions from their measurements. How much mass was lost from the wood in the test tube? Where did this extra mass go? What was the mass of the gas?

   Note: The lost mass will not tell you precisely how much gas was produced, because not all gases will burn.

2. Would this be an efficient way of producing biofuels? Discuss why or why not. You may want to discuss the advantages and disadvantages of using energy to convert biomass to biofuels.
3. Assign independent research projects on biomass. Possible topics are:
   - biomass from crop and animal waste or from human trash
   - different kinds of biomass and how they are used as energy sources
   - biofuels that are used today, such as ethanol, methanol, or syngas
   - techniques of biofuel conversion
   - potential future biofuels or sources of biomass
   - advantages and disadvantages of biomass use
   - biomass and land-use issues

This activity was adapted from *Science Projects in Renewable Energy and Energy Efficiency*, compiled by the National Renewable Energy Laboratory, Boulder, Colorado, 1991.

Living Lightly on the Planet Volume II

Schlitz Audubon Center
1111 East Brown Deer Road
Milwaukee, WI 53217
414-352-2880
414-352-6091 (fax)

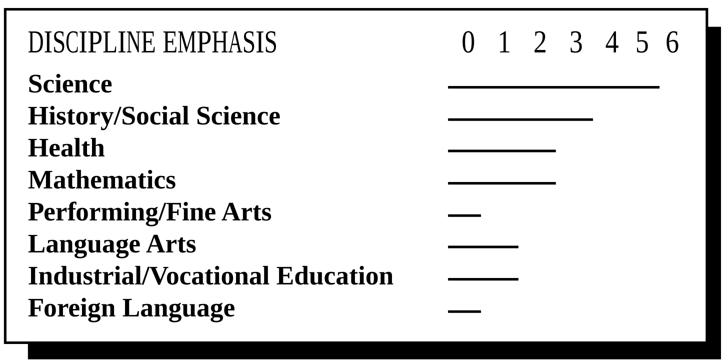
$25 per volume (plus shipping and handling); 205 pages, 1987.

Grades 10-12

This curriculum provides students the opportunity to encounter a variety of viewpoints, examine and clarify their own values, and evaluate some possible alternatives for solving environmental problems.

REPORT CARD

Overall Grade	**A-**
General Content	**B+**
Presentation	**B+**
Pedagogy	**B+**
Teacher Usability	**B_**
Energy Content	**A-**



COMMENTS

General Content
Great for grades 10-12—expectations are appropriate for the level. Provides broad coverage of human impacts on the environment.

Presentation
Concepts presented in lab activities are well thought out. Good case studies. Gray background on text makes reading difficult.

Pedagogy
Numerous student activities involve collaborative learning, role playing, and critical thinking. Assessment tools are only implied.

Teacher Usability
Good topic index at the end. Inconsistent level of background/support materials.

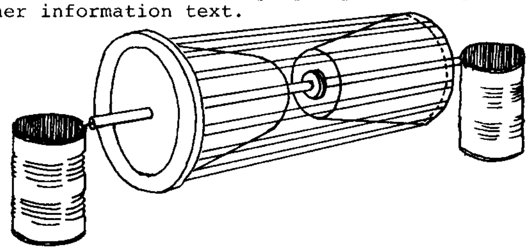
Energy Content
A good presentation and comparison of new energy technologies.

DESIGNING WITH THE SUN **Student Information Sheet**

SOLAR ENGINE

By Edward D. Ray, Inventor

Materials needed: single-edge razor, sharp pencil, flat file, compass, scissors, ruler, two soup cans, two 14 oz. white foam cups, one medium- or large-size white plastic foam plate (such as fresh meat is packaged in), 1/4 inch diameter, 12 inches-long wood dowel, two straight pins, four paper clips, one sheet medium sandpaper, 1/4 inch drill bit, epoxy glue, contact cement, a six- or seven-inch diameter plastic lid, and black polyethylene strips as described in teacher information text.



Directions:

1. With the compass draw two circles on the plastic foam plate with a diameter equal to the inside diameter of the tops of the plastic foam cups. Draw four more circles one inch in diameter. Cut out all the circular disks using the single-edge razor blade. Using the sharp pencil with a twisting motion from both disk sides, punch holes in the centers of all disks so that each fits snugly over the dowel. The dowel should have its ends slightly rounded with the sandpaper.

2. Sand down the edges of the large disks on a slant, so that each disk fits snugly recessed 1/4 inch below each cup end. This will make both cups rigid. Using the 1/4 inch drill bit, carefully drill by hand a 1/4 inch diameter hole in the center of the bottom of each cup.

3. Find the centers of the ends of the dowel and insert the straight pins 1/4 inch into the centers. Take care that the pins provide a centered spin-axis.

4. Mark the center of the dowel length. Assemble the rotor as shown in the drawing. Ensure a good quick-set epoxy bonding of all parts, but do not bond one of the large disks to the dowel.

5. Coat 1/4 inch inner lip of each cup with quick-set epoxy. This provides a surface for gluing the Solar Muscle strips to the cup lips with contact cement. Otherwise, the contact cement will dissolve the plastic foam.

6. After the epoxy has thoroughly set, cut a half-inch radius center hole in the large disk that was not glued to the dowel. Remove the cutout disk from the dowel. This allows one of the cups to wobble about the dowel axis.

7. Now take a SM strip you stretched previously, hold it against both cup ends, and cut it to length so that 1/4 inch extends beyond each cup end. Cut 24 strips this way. Apply contact cement to the epoxy surface on the inner lip of each cup and to the 1/4 inch ends of the SM strips. Keep each ring of contact cement well inside the epoxy-coated surface to avoid dissolving the foam.

8. Attach the SM strips symmetrically around the cups, parallel to the dowel, with each end of each strip cemented to the cups' inner lips. No two strips should touch along the rotor, and spacing between the strips should not exceed the strips' width. The design is forgiving in that only a few strips will drive the rotor, but the object is to attach as many strips as possible, symmetrically, while allowing some cooling space between the strips. In attaching the SM strips, take up all the slack in them, but apply only slight tension to flatten the strips. The "smart" plastic knows the right amount of tension, and this tension will automatically be taken up when the rotor turns in the sun.

9. File a notch in the rim of each soup can in which the pins can turn freely. Weight the cans with sand or dirt so they won't easily tip.

10. Place the rotor on its soup-can friction bearings in a sunny window and, by hand, rotate the motor slowly until the SM tightens to assume its natural tension. About five minutes of slow turning in bright sun will complete the process. Remove the rotor from sunlight.

11. Cut a two-inch-diameter hole at the center of the plastic lid. Apply a cup-size ring of contact cement to the underside of the plastic lid in a half-inch ring for later attachment to the "wobbly" cup top. Apply contact cement very lightly around the rim of the wobbly cup.

12. Attach the plastic-lid flywheel (not shown in illustration) to the wobbly cup rim, being careful to center it on the axle (more important than centering on the cup). Balance the rotor by attaching paper clips to the rim of the flywheel.

13. Place the solar motor in a sunny window, and it will turn at about 50 rpm. It turns fastest with the sun directly above, but if well balanced, it will run slowly till late in the day. You'll note that the motor will self-start and run in both directions, but it prefers to turn top over to the sun. As you've probably guessed, the motor turns by the SM contracting on the hot side and relaxing on the shaded side, thereby constantly lifting the flywheel above the rotor's center of gravity and allowing it to continuously "fall around."

Issues, Evidence and You

Sargent-Welch
P.O. Box 5229
Buffalo Grove, IL 60089-5229
1-800-727-4368
1-800-676-2540 (fax)
http://www.sargentwelch.com

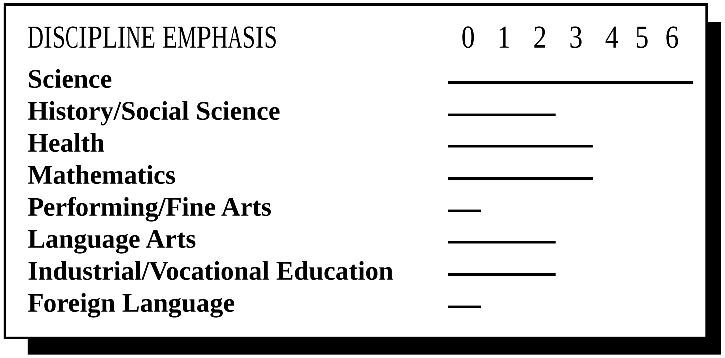
$4,028.99 (full year course which includes materials kit with equipment for 5 classes of 32 students, teacher's manual, and 32 sets of student books - replacement books available); 1995.

Grades 7-12. Evaluation based on review of materials for grades 10-12.

A diverse educational program highlighting science and its uses in the context of societal issues.

REPORT CARD

Overall Grade	**A-**
General Content	**A-**
Presentation	**A-**
Pedagogy	**B+**
Teacher Usability	**A**
Energy Content	**A-**



COMMENTS

General Content
Raises real-world questions for which there may be multiple solutions. Activities are thematically tied together.

Presentation
The criteria for instructional materials is excellent.

Pedagogy
Fun, hands-on activities.

Teacher Usability
Student activity books and materials must be ordered from specific providers. Does not consider time limitations of typical high school periods.

Energy Content
Set of 12 units addressing various aspects of energy uses, sources, and quantification of energy transfer/loss process.

Additional Teacher Thoughts
This appears easy to use and teaches great science while having kids work on scenarios and apply their learning.

Activity 57 Controlling Radiant Energy Transfer

A "Reflective" Question

Introduction

In the last activity, you did investigations to find out how to capture and store energy from the sun. In this activity, you will look at methods for preventing unwanted heating by the sun.

Challenge

Learn how the transfer of energy from the sun can be controlled by special materials.

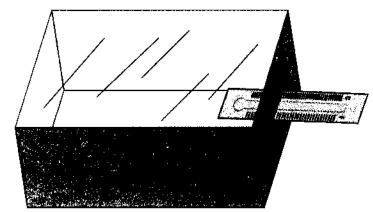
Materials

For each group of four:

- Two metal-backed thermometers
- One piece of clear plastic film
- One piece of reflective plastic film
- Two prefolded boxes
- Masking tape (approximately 30 cm or 12 inches)

Procedure

Look at your two pieces of plastic film. Plan an investigation that will allow you to compare the ability of these two plastic films to prevent the transfer of the sun's heat through a window into a room. Use the box and thermometer as shown below to simulate a room with a window. Carry out your investigation.



1. Write a summary describing the results of your investigation.
2. Think about the investigations you did in the last two activities. There were some similarities and some differences between the investigations. Describe how you used materials to accomplish the different energy transfer goals in Activities 56 and 57.

   Be sure to identify:

   a) the energy chains involved;

   b) the effect of the materials chosen on the energy transfer; and

   c) the results of the decisions made in each case.

Electric Vehicle Classroom Kit

EV Media
612 Colorado Ave., Suite 111
Santa Monica, CA 90401
310-394-3980
310-394-3539 (fax)

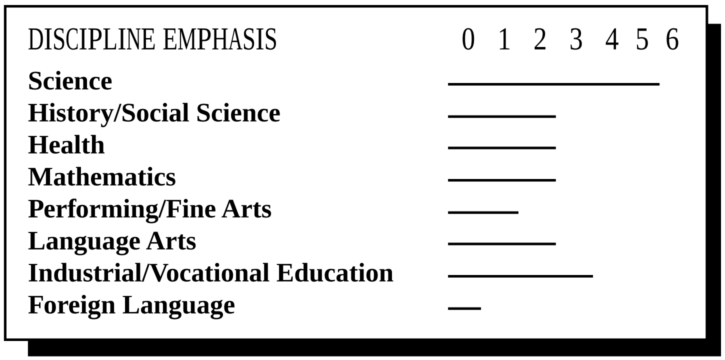
Kits start at $139.50 (includes a 121 page teacher’s book, 35 student booklets, and five model car kits); 1996.

Grades 7-12. Evaluation based on review of materials for grades 10-12.

The teacher’s book provides information and suggestions for conducting a unit; the unit is built around a sequence of activities, some of which are optional.

REPORT CARD

Overall Grade	**B+**
General Content	**B+**
Presentation	**B+**
Pedagogy	**A-**
Teacher Usability	**B+**
Energy Content	**B+**



COMMENTS

General Content
A well-integrated approach to energy conservation through the application of science and technology. Prepares students for the future.

Presentation
Exceptionally clear and thorough teacher directions. Artistic layout of instructional materials is appealing.

Pedagogy
Assessments are excellent. Good group projects.

Teacher Usability
Narrow focus on energy and transportation limits the scope of how and where a teacher would use the unit. Suggestions for materials in kit are given so teachers can purchase the teacher’s edition and not the kit and still get the materials for making the cars.

How Can We Measure the Concentration of Air Pollutants?

Overview
This optional lesson demonstrates how the concentration of an air pollutant can be measured.

Processes
Observe.
Communicate.
Compare.

Objectives
Experience
✓ detecting a substance through a chemical change.
Know
✓ Substances present in very small amounts can have detectable effects.
Are Able to Do
✓ relate descriptions of concentration to quantities in a given volume (or mass, depending on how the concentration was expressed).

Assessment
Evaluate the worksheets for completeness.

Heterogeneous grouping
Besides reagents and some equipment, this activity requires some careful reasoning by students.

A little background
Does the air we breathe really contain "chemicals" other than the gases with which students are familiar? An investigation can show that it does (if indeed it does), and if you wish, the results can be roughly quantitative.

One way of testing for the presence of sulfur dioxide in the air is to bubble it through a solution of potassium permanganate in water; the purple solution will become almost colorless (the manganese sulfate is slightly pink). The reaction is:

$$2KMnO_4 + 5SO_2 + 2H_2O \rightarrow K_2SO_4 + 2MnSO_4 + 2H_2SO_4$$

By finding the masses of the 2 potassium permanganate molecules and the 5 sulfur dioxide molecules, we can use this reaction to determine the mass of sulfur dioxide in a quantity of air.

Potassium	39.10	times 1 =	39.10
Manganese	54.94	times 1 =	59.94
Oxygen	16.00	times 4 =	64.00

for a total of 158.04 atomic mass units for one molecule, or 316.08 atomic mass units for 2 molecules. For the sulfur dioxide,

Sulfur	32.06	times 1 =	32.06
Oxygen	16.00	times 2 =	32.00

for a total of 64.06 atomic mass units for one molecule, or 320.30 for 5 molecules.

So the ratio of the mass of potassium permanganate to the mass of sulfur dioxide needed to decolorize it is 316.08:320.30, which is 0.99:1. So 1 gram of sulfur dioxide decolorizes 0.99 gram of potassium permanganate.

This reaction requires an acidic environment, which we can ensure by adding a few drops of hydrochloric acid.

Materials needed
- ❑ potassium permanganate
- ❑ dilute hydrochloric acid
- ❑ aquarium air pump
- ❑ 250-mL Erlenmeyer flask or similar bottle
- ❑ 2-hole rubber stopper to fit above flask
- ❑ glass tubing to fit above stopper; one piece about 7.5 cm long, the other long enough to reach almost to the bottom of the flask. If you have to cut the tubing, fire polish the ends.

- ❑ rubber or plastic tubing. It often happens that the diameter of the output tube on the air pump is not the same as the diameter of the glass tubing in the rubber stopper. Rubber tubing can sometimes stretch to accommodate both, but vinyl and Tygon won't, in which case you may need to make a small adapter from a short length of the glass tubing. Heat the tubing over a flame and pull it out to reduce the diameter to equal that on the air pump. (It is easy to get it too small!) After it cools, score the middle of the waist and break it off.
- ❑ stirring rod
- ❑ balance, weighing paper or pan
- ❑ 125-mL or so bottle to store stock solution
- ❑ 100-mL graduated cylinder
- ❑ two 1-mL pipettes

Preparing the stock solution
Weigh out 0.99 gram of potassium permanganate. Add to 50 mL of distilled water and stir until dissolved. Pour the 50 mL of solution into a 100 mL graduated cylinder or volumetric flask and add distilled water to bring to 100 mL. Store this solution in a tightly stoppered, labeled bottle of about 100 mL capacity. Don't make this stock solution in large quantities, because it deteriorates on exposure to the air.

Preparing the flask for the investigation
Because inserting glass tubing through stoppers is a potentially hazardous procedure for inexperienced students, we suggest you prepare the flask in advance.

Pour 100 mL of distilled water into the flask. With a pipette, add 1 mL of the 0.99% potassium permanganate solution. With another pipette, add 1 mL of dilute hydrochloric acid.

Insert a stopper with two glass tubes, one short and the other reaching almost to the bottom of the flask, well below the surface of the solution. Plastic tubing from the air pump is to be attached to this second tube.

Interferences
Certain other substances can decolorize the solution, in particular sulfates (adsorbed on particulates). But the test is still a good way of demonstrating the principles behind measuring concentrations of air pollutants.

Energy, Economics and the Environment

Indiana Department of Education
Office of Program Development
Attn: Rose Sloan
Room 229, State House
Indianapolis, IN 46204-2798
317-232-9186
317-232-9121 (fax)

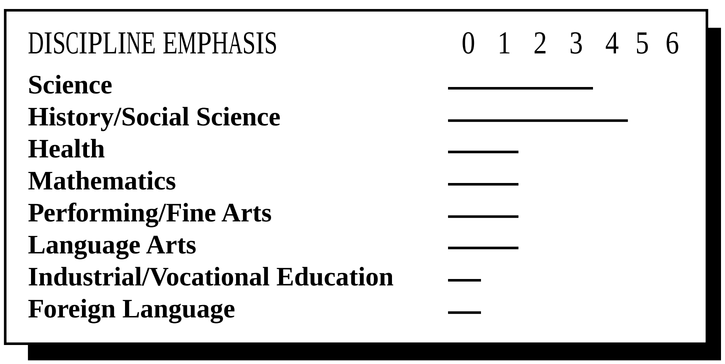
$8 per copy; 155 pages.

Grades 10-12

This curriculum provides a conceptual framework for analyzing energy and environmental issues, and provides teachers with a set of motivational, interdisciplinary teaching units centering on these important issues.

REPORT CARD

Overall Grade	**B**
General Content	**B+**
Presentation	**B**
Pedagogy	**B**
Teacher Usability	**B-**
Energy Content	**B+**



COMMENTS

General Content
Strong bias to consumption and profit.

Presentation
Scenarios are good. Good evaluation model provided to deal with difficult questions.

Pedagogy
Some activities are open ended and collaborative.

Teacher Usability
Requires more of an economics background than most science teachers may have.

Energy Content
Specific to renewable energy resources.

Activity 8

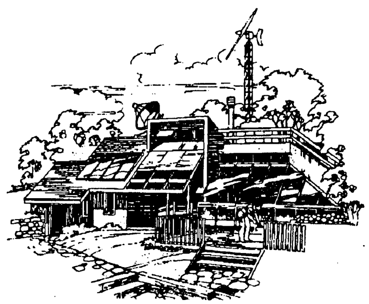
Case Study

The Case of the Energy Subsidy

Student Directions:

1. The Senate is considering energy policies to give tax breaks to renewable energy sources and to increase taxes on fossil fuels. You will be asked to take part in public hearings involving these issues.
2. After you research the various energy sources, you will be assigned a role as either a senator or one of the lobbyists representing various special interests and geographic regions.
3. Fill out a Decision Worksheet and Decision-Making Grid to help you come to a decision. Much depends on you. Good luck.

SCENARIO



The year is 1998. United States dependence on foreign petroleum, which became a problem in the early 1970s, continues to grow. In addition, concern rises over the environmental costs associated with the use of fossil fuels. Renewable energy sources are an option in some regions, but they have been slow to develop commercially. Connecticut, for example, has access to hydroelectric power, but usage has actually declined during the past century, because of relatively cheap fossil fuels. To help change this trend, Connecticut Senator Jonathan Barnhart has sponsored a bill to provide special tax breaks, or subsidies, for developers of renewable energy sources, including solar, wind, geothermal, hydropower, and biomass. These tax subsidies would take the form of tax credits, or rebates, for qualifying energy projects.

Senator Barnhart's proposal received mixed reviews in the Senate. Senators from the five top oil producing states – Texas, Alaska, Louisiana, California. and Oklahoma – expressed concern that the bill would put oil producers at a disadvantage that could result in serious job losses in their states. Three of those states, Texas, Louisiana, and Oklahoma, are also the top producers of natural gas, leading their senators to argue even more strongly against a subsidy for competing renewable fuels. Noting that renewable fuels are not yet competitive in price without tax subsidies, they argue that consumers would get the best product at the lowest price by letting the market determine what type of energy to produce and in what quantities. In addition,

they object to any programs that would increase the size of the federal budget deficit at a time when program cuts and tax hikes are being proposed to deal with the out-of-control federal budget.

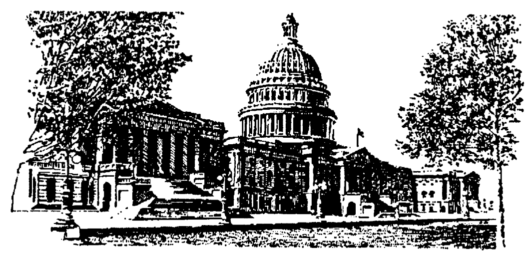
Environmental groups and developers of renewable energy sources disagree. They claim that fossil fuels already receive a subsidy from the general public in the form of environmental damage that does not get charged back to those who are responsible. They assert that fossil fuels would cost a lot more if the environmental costs to society were included. According to the environmentalists, we tend to be short-sighted in dealing with nonrenewable resources by not taking into account their finite nature until it is too late.

Oil company representatives respond that it was the free market that developed petroleum back in the mid-nineteenth century when whales became relatively scarce and there was concern that they might be driven to extinction. Oklahoma Senator Susan Phillips reminds Senator Barnhart that we avoided a whale oil crisis a century ago not through special subsidies, but through the free market responding to a shortage of whale oil by raising its price. Says Senator Phillips, "The higher price of whale oil actually created a market for petroleum and other energy sources by encouraging both consumers and producers to look for cheaper alternatives."

The president of the Sierra Club, Belinda Arbuckle disagreed. "For free markets to operate effectively, people need to pay the full cost of their actions. Our failure to take into account the full long-run costs of fossil fuels to society makes it difficult for producers of renewable energy sources to compete. I proposed new taxes on fossil fuels reflecting the environmental damage associated with their production and use. This would tend to increase the cost of fossil fuels reflecting their environmental impact and making it easier for renewable energy sources to compete on the basis of price."

The fossil fuel industry response is that we do not need another tax on energy to clean up the environment, especially in light of the mixed scientific evidence on the damaging effects of sulfur dioxide and other pollutants from fossil fuels. The industry also reminds the Senators that an energy tax would have negative effects on jobs and growth throughout an economy dependent on fossil fuels.

The Senate is undecided about what to do, and is calling for special hearings. Should the Senate, 1) support the Barnhart proposal to grant subsidies to producers of renewable energy, 2) support the Sierra Club proposal to tax fossil fuels, or 3) do neither and let free markets determine energy use?



Energizing Your Future with Energy, Economics and the Environment.

National 4-H Council
National 4-H Supply Service
c/o Cresstar Bank
P.O. Box 79126
Baltimore, MD 21279-0126
301-961-2934
301-961-2937 (fax)

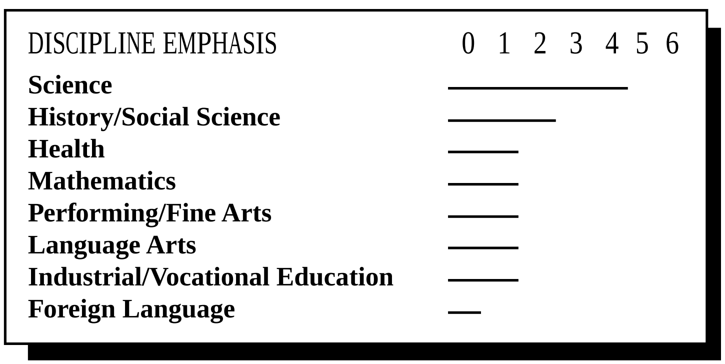
Item #ES1009: $5 per copy, 1996.

Grades K-12. Evaluation based on review of materials for grades 10-12.

This guide contains five chapters, each focusing on a different topic related to the interrelationships between energy, economics, and the environment.

REPORT CARD

Overall Grade	**B**
General Content	**B**
Presentation	**B+**
Pedagogy	**B**
Teacher Usability	**B**
Energy Content	**B+**



COMMENTS

General Content
Sound activities that encourage students to explore environmental topics. Activities may not be challenging to upper high school students.

Presentation
Good, simple, clear activities.

Pedagogy
Wide variety of activities involving games, contests, role playing, and group discussion.

Teacher Usability
Good resource references. More appropriate for mixed age, informal education groups.

Activity 5.2
A Matter of Invention

Activity Goals
To discuss global options for alternative sources of energy.

Preview
Participants discuss options for alternative sources of energy and design inventions using these sources.

Ages: 9 to 18
Style: adult
Life Skills: speaking before a group, understanding and using new technologies, identifying problems, planning for the future, leading change
Pre-Activities: 2.1, 2.2, 2.3, 3.4, 5.1
Time Needed: 30 minutes
Group Size: any
Indoors or Outdoors: either
Materials Needed: copies of Activity Sheets 5.2A and 5.2B cut into cards, art paper, pencils, crayons, markers, toothpicks, modeling clay, papier mache', glue, craft sticks, other art materials (see Activity)

How to Do the Activity
Ask participants to name their favorite inventions from the last 200 years. Write their responses on a chalkboard or flip chart. Here are some to get you started:

television
washing machine
computer
CD player
automobile
skateboard
bicycle

Ask them to name the energy sources used to run these inventions. On the chalkboard or flip chart, draw an arrow from the invention to the energy source. If it's electricity, write down the primary source of electricity in your area, e.g.:

television __________ electricity________coal

Do this for several examples. Point out to participants that historically, as new sources of energy have been discovered, inventions were created to use them. For example, when electricity became widely available, the toaster, television, and stereo became possible.

Ask participants what things might be invented if alternative energy sources were more developed. What would our lives be like if we used alternative energy sources to run our favorite inventions?

Divide the group into teams of three or four. Hand out one prepared card from each activity sheet to each team. Give them the following assignment: Design an invention that can be used in the assigned country using the fuel named. It should replace one of the items from the favorite invention list participants generated earlier. For example, a team may draw a biomass card and Papua New Guinea card. A favorite invention might be a television. Therefore, team members would have to design a television that runs on wood or crops that can be used in Papua New Guinea. They would have to speculate whether the fuel is abundant, giving the description of the country. They also

should consider whether the invention is energy efficient.

Give the teams art supplies. Have them sketch or build a model of their design. They can make the artwork as elaborate or simple as they wish.

When teams are done, let each share its invention with the group. Do any participants have ideas for improving the invention? Would the invention be widely used in the country it is built for? How difficult would it be to harness the alternative energy source for the invention?

Evaluating Progress
Name some alternative energy sources being used today. What effect would your invention have on people if it were used?

Fair Game
Use your invention as an exhibit! Include information on the energy source, such as availability and how it is generated.

One for All and All for One
Think globally! Energy use is different in every country. Tiny Nepal holds eight of the 10 tallest mountain peaks in the world. Water comes rushing down these mountains, providing the source of most of the electricity in the country. But people who live in Nepal also rely heavily on wood and agricultural residues for heating and cooking. Energy ideas that may be accepted in another country, such as using a windmill to pump water from underground, may not be practical for Nepal.

As a group, become more familiar with our global neighbors. Pick a country to research. You can have a special celebration and serve traditional foods cooked using traditional methods.

Energy Use

Global Systems Science
Lawrence Hall of Science
University of California
Berkeley, CA 94720-5200
510-642-0552
510-642-1055 (fax)
email: csneider@uclink4.berkeley.edu

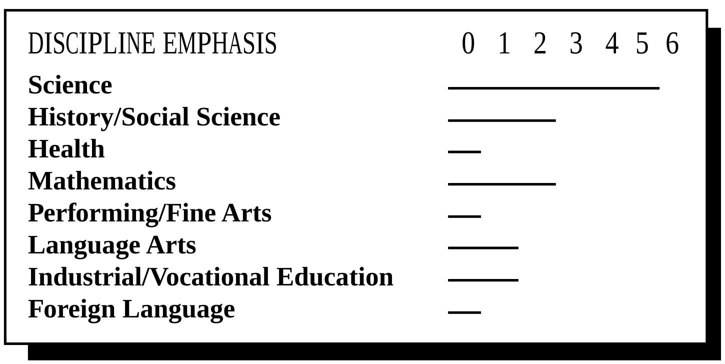
Call or write for price information and availability of trial edition (under development).
30 page teacher's guide, 102 page student guide; 1995.

Grades 10-12

An interdisciplinary course for high school students that emphasizes how scientists from a wide variety of fields work together to understand significant problems of global impact.

REPORT CARD

Overall Grade	**B**
General Content	**B+**
Presentation	**B-**
Pedagogy	**C+**
Teacher Usability	**C+**
Energy Content	**B+**



COMMENTS

General Content
Content is thematically organized and holds great potential for in depth student learning.

Presentation
Great for students who like to read. Easy to overlook some activities.

Pedagogy
Only three student activities per unit; seems book centered.

Teacher Usability
Good for a reference.

Energy Content
Most of the material focuses on electrical energy.

Chapter 5

The Electric Power Grid

As electric companies grew, power plants were linked together in networks which covered different regions of the country. But by the start of the 1960's there was not yet a single unified network. Different networks even provided different frequencies of alternating current, ranging from 25 to 60 cycles per second. Continued growth and development required a standard for the country. The Federal Energy Regulatory Commission (FERC) and state utility commissions were organized, and today they coordinate the growth of huge power networks, containing hundreds of power plants, called the *electric power grid*. The power grid links users and producers of electrical power in the United States and parts of Canada.

In order for different generators to feed power into the grid they must be working at the same speed to produce the same frequency of AC. Each generator must be pushing the current forward at the same time, and each must reverse the current at the same time. If one generator is shut down for a while, it must be brought up to speed before it is connected to the others so that all the generators operate in synchrony with each other. Each generator operates in lock-step with every other generator; and all of these power plants are connected to streetlights, electric trains, factories, homes, and business.

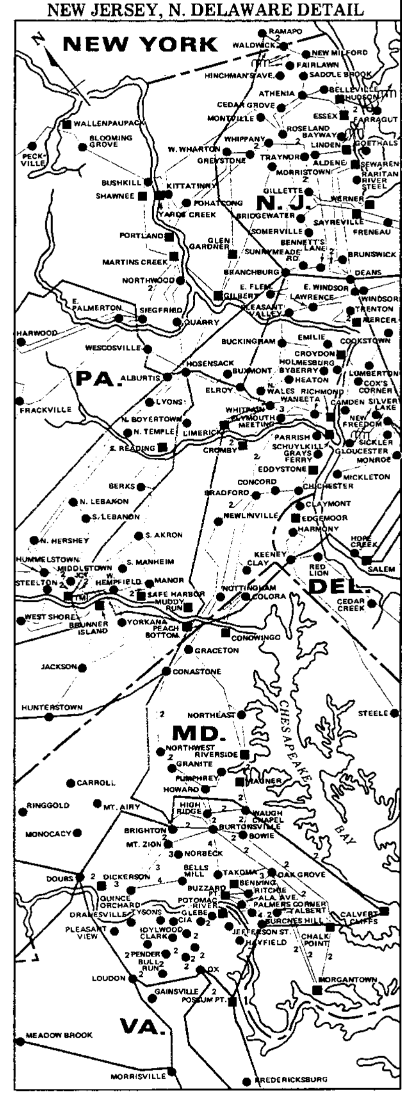
Sectional Maps of the North American Power grid

Courtesy of North American Electric Reliance Council, 1994

Transmission Lines
Numbered Lines depict Multiple Circuits.

	Existing Lines	Future Lines
Direct Current		
735/765 kV.		
500 kV.		
345 kV.		
230 kV.		
Below 230 kV.		
Power Station	■	
Substation	●	

E. PENNSYLVANIA, MARYLAND, NEW JERSEY, N. DELAWARE DETAIL



Daily operation of the power grid

Imagine millions of people returning home at the end of a hot work day in summer, turning on lights and air conditioners. As the load on the power grid increases, more energy is required to turn the generators. At first they start to slow down. Voltage goes down. AC frequency goes down.

This would be an emergency if it were allowed to continue. Electrical usage requires about 120 V at nearly exactly 60 cycles per second. Before the frequency drops even to 59 cycles per second the change is detected in the system control room which monitors the operation of the power grid for a power company's service area. Power plants that have been standing ready are brought on line. The power generated matches the load and the frequency goes back to 60 cycles per second.

In the early evening people switch off lights and appliances as everyone goes to bed. As the load goes down, generators are disconnected from the grid. This cycle happens every day.

4-H Home Conservation Guide

California Energy Commission
Education Information
1516 Ninth Street, MS 29
Sacramento, CA 95814
916-654-4989
916-654-4420 (fax)
http://www.energy.ca.gov/education

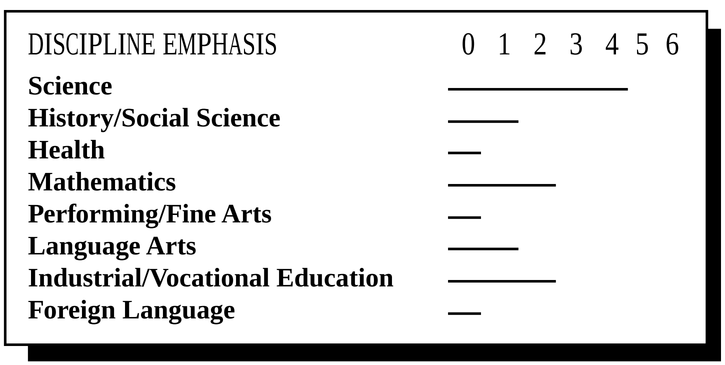
$1.50 per copy.

Grades 4-12. Evaluation based on materials for grades 10-12.

A collection of hands-on projects accompanied by background information which teach home energy conservation skills.

REPORT CARD

Overall Grade	**B**
General Content	**C+**
Presentation	**B**
Pedagogy	**B**
Teacher Usability	**B+**
Energy Content	**C+**



COMMENTS

General Content
Straight forward, practical, hands-on solutions to increasing energy efficiency in homes.

Presentation
Practical instructions with useful illustrations.

Pedagogy
Excellent energy resource for student involvement in activities utilizing authentic assessment.

Teacher Usability
Some of the projects are very appropriate for all levels of high school students, especially as community service projects.

Energy Content
Several activities allow the students to apply the principles of energy conservation directly in their homes.

STORM WINDOWS

OBJECTIVE: To build effective yet inexpensive storm windows to weatherize windows in homes or other buildings.

ENERGY CONNECTION: A single pane window has an R valve less than one.(Remember: The higher the R-value, the better a material is at insulating.) A window can lose 230 times more heat from your house than an insulated wall of the same area. A double glazed window or storm window can halve that amount.

AUDIENCE: 4-H members with some carpentry skills can assemble this simple straightforward project with minimal assistance from adults..

TIME: 1-2 days

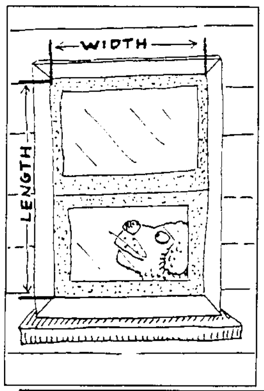
PREPARATION: The directions for members are very detailed and contain a list of tools and materials for the project. Members may need help with measuring to figure out the quantity of materials. If a member doesn't have wood trim on any of their home windows you may want to help them identify a window on another building. This project is relatively inexpensive but will require purchasing materials, some basic tools and an outdoor or shop work environment.

WHAT YOU WILL DO

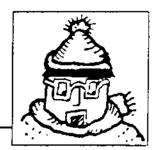
If several members in your group are interested in this project you may want to assemble a sample storm window as a group at your meeting.

Members could have difficulty with the following steps in this project: measuring lengths and widths, cutting 45 degree angles and assembling frames with corrugated fasteners. You may want to review these steps with interested members.

Corner braces may be used in place of corrugated fasteners and if UV treated polyethylene is not available, regular polyethylene can be used, but it won't last as long.



Storm windows could be constructed for a local community building in need of weatherization. Refer to the community project activity in this packet.



MATERIALS GUIDE

WEATHERSTRIPPING DOORS AND WINDOWS
WHAT'S AVAILABLE AND WHAT'S BEST

Here is background information on what the different types of weatherstripping look like, how they work and when is it best to use them. It would be helpful for you to review this information before you start the unit so that you are familiar with weatherstripping materials. You may want to take this packet in a local hardware store to see what types of materials are available in your community.

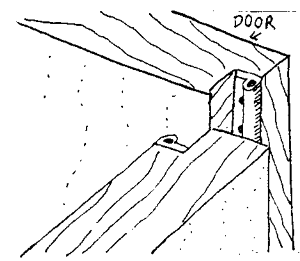
Be aware that there are a wide variety of windows and doors and each requires different types of weatherstripping for the best results. Parents may want a copy of this information if their child is doing a weatherstripping project at home.

We recommend that you encourage members to use this information to try a simple weatherstripping project with their families or do one as a group on a local building.

FACT BOX

If all the small unsealed spaces in a room were combined they could equal a hole the size of a soccer ball. A hole that size would let in quite a breeze.! In older homes 50% of the heat loss can be from infiltration. Weatherstripping can reduce that loss to 10%. Stopping infiltration with weatherstripping should be a first step in weatherizing your home. It is relatively easy and inexpensive.

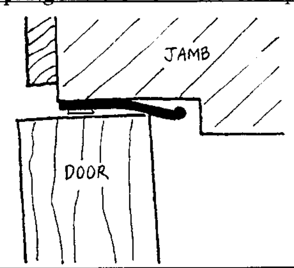
JAMB WEATHERSTRIPPING



Interlocking jamb weatherstripping - (doors) is composed of two parts, one attaches to the door edge and the other to the jamb. They interlock when the door has closed, forming a seal.

Advantage - works well where there are extreme water problems **Disadvantage** - in cold climates can be damaged by ice, rocks can get in channels and damage them

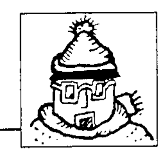
Spring and cushion weatherstripping - are flexible metal or plastic strips which compress to form a seal when a door or window is closed. (used on doors, sliding windows, & sash windows)



Advantages - concealed, excellent seal (looks best, but difficult to install)

Disadvantages - makes doors and windows harder to close, noisier than otherkinds, can wear out because of friction

Rigid gasket weatherstripping - (doors, sash windows) is composed of a gasket



Supplementary Materials

The following materials were evaluated as "supplementary materials." These items show value as teaching materials, but may narrowly focus on a specific energy topic or closely related topic, or they may be a collection of unrelated activities or fact sheets. Evaluators applied the narrative portions of the evaluation tool to these materials; a summary of their notes is provided here.

ACID RAIN

LHS Great Explorations in Math and Science (GEMS)
Lawrence Hall of Science
University of California
Berkeley, CA 94720
510-642-7771
510-643-0309 (fax)
http://www.lhs.berkeley.edu

Grades 6-10. $16 per unit (does not include tax or shipping and handling); 163 pages, 1990.

This unit engages students in discovery activities, brainstorming acid rain solutions and critically evaluating those solutions, and formulating their own opinions about what should be done about acid rain.

Notes: Includes a simulation for students to determine solutions to acid rain. Great teacher instructions. Includes a literature list. Relates acid rain effect on lakes and fish in a realistic manner. Presents a logically organized sequence of lessons. Clear, step-by-step directions. Good upper elementary and middle school activities. Very structured.

TEACHER'S GUIDE TO SUPERCONDUCTIVITY FOR HIGH SCHOOL STUDENTS

National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Rd.
Springfield, VA 22161
703-487-4650/800-553-6847
703-321-8547 (fax)
http://www.ntis.gov

High School. Item #PB95141388, $21.50 plus $4 shipping and handling; 77 pages plus 12 minute video, 1994.

This handbook and video were developed to help teachers understand, teach, and demonstrate the basic features of superconductivity.

Notes: An excellent physics activity with a video tape. Extensive background information. Many advanced-level exercises. May be intimidating to some teachers. Presents high-level math, including calculus. Requires a lot of specialized equipment, i.e. oxygen tank, pellet press, etc. Would not be used in some classrooms mainly because of materials needed and storage problems with liquid nitrogen. Better equipped schools could do this.

BREAKTHROUGHS (several titles): *Antarctica: Exploration or Exploitation?; Can We Plug Into Windmills?;* and ***Smog, Sore Throats, and Me?***

Zaner-Bloser Inc.
P.O. Box 16764
Columbus, OH 43216-6764

1-800-421-3018
614-487-2699 (fax)

Antarctica: Exploration or Exploitation? (3-4), ***Can We Plug Into Windmills?*** (2-3), and ***Smog, Sore Throats, and Me?*** (3-4). Each package comes with a teachers edition, student response sheets, and a science workbook. Packages are available with 5, 15, or 25 student response sheets for $24.97, $59.97, or $89.97. Materials are available in Spanish.

The topics in “Breakthroughs” are real-world problems, and can supplement various disciplines. Units are developed around a non-graded scope of topics rather than on a scope and sequence of skills.

Notes: Student books have engaging text and pictures. Emphasizes reading information and answering questions. Tries to move to a project approach but is not there yet. Many of the more interesting, integrated ideas are optional. It is not activity based. Addresses thinking strategies.

EARTH MATTERS

Zero Population Growth Inc.
1400 16th St., N.W., Suite 320
Washington, DC 20036
202-332-2200
202-332-2302 (fax)
http://www.zpg.org

High school. $19.95 plus $3 shipping and handling. 177 pages, 1991.

Twelve readings and 32 activities introduce high school students to global environmental issues, challenging them to critically evaluate issues, and motivating them to develop solutions.

Notes: Looks at global issues and problems such as population, distribution of wealth, and ethics. Can be used across the curriculum in a variety of subject areas. Nice summary of activities for easy reference at the beginning of the book. Good as a starting point in a unit. Limited hands-on activities.

ENERGY ACTION ACTIVITIES

National Energy Foundation
5225 Wiley Post Way, Suite 170
Salt Lake City, UT 84116
801-539-1406/ 1-800-616-TEAM
801-539-1451 (fax)
http://www.nes1.org
e-mail: info@nef1.org (can send orders via e-mail)

Grades 4-8. $12 plus $3 shipping and handling (10% for orders of $30 or more). Teachers receive a 20% discount upon request. 77 pages, 1993.

The activities are designed to help teach students about energy and the environment. Family participation is encouraged in each activity.

Notes: Strong focus on conservation. Suited for home-school connections, not for use in school. Encourages environmental awareness through ethical choices. Interesting variety of activities. Format is appealing to students. Does not indicate age or grade level.

ELEMENTARY ENERGY AND ENVIRONMENT SCIENCE ACTIVITIES BOOK V

Department of Environmental Protection
Office of Pollution Prevention and Compliance Assistance
P.O. Box 2063
400 Market St., 16th floor
Harrisburg, PA 17105-2063
717-783-0540
717-783-2703 (fax)
http://www.dep.state.pa.us

Grade-level designation is left to the teacher's discretion.
Free. 99 Pages, 1997.

The activities are designed to help teachers incorporate energy concepts into the curriculum.

Notes: An abundance of activity sheets to supplement a primary unit on energy. Some good supplements to an energy unit. Worksheet oriented and teacher directed. Includes an interesting vocabulary list showing the Greek and Latin origins of words. Includes ideas for energy bulletin boards.

ENERGY ACTION PATROL

National Energy Foundation
5225 Wiley Post Way, Suite 170
Salt Lake City, UT 84116
801-539-1406/ 1-800-616-TEAM
801-539-1451 (fax)
http://www.nes1.org
e-mail: info@nef1.org (can send orders via e-mail)

Grades 5-8. $450 (plus 10% shipping and handling). Teachers receive a 20% discount upon request. 1995.

This kit includes program guidelines, instructions, and other support materials for Student Energy Action Patrols to conduct regularly scheduled school energy audits.

Notes: Filled with action activities that students can complete; puts energy conservation into perspective. Includes very little background for the teacher. Activities are mostly individually structured; few opportunities for real cooperative learning to occur. Although assessment seems to be imbedded in the curriculum, there is no direction given to the teacher. Good, explanatory video. Relies heavily on reading; no provisions given for Limited English Proficiency students. This program involves students in monitoring their school energy usage and encourages them to continue these efficiency and conservation measures at home.

ENERGY ACTION TEAM

National Energy Foundation
5225 Wiley Post Way, Suite 170
Salt Lake City, UT 84116
801-539-1406/ 1-800-616-TEAM
801-539-1451 (fax)
http://www.nes1.org
e-mail: info@nef1.org (can send orders via e-mail)
Grades 6-9. $100 (plus 10% shipping and handling). Teachers receive a 20% discount upon request. 1995.

This program provides young adults the opportunity to work as a team in research, preparation, and submittal of a school energy efficiency policy.

Notes: Students participate in this program directly; in that sense, it may be empowering…they can make a difference. This is a good collection of energy awareness activities which include a parent involvement component. The idea of earning Eco Action points toward a goal could be very motivating for students. To use this book with any meaning, it would be necessary to have taught the 4-6th grade materials, which provide the theoretical background.

ENERGY ACTION TECHNOLOGY

National Energy Foundation
5225 Wiley Post Way, Suite 170
Salt Lake City, UT 84116
801-539-1406/ 1-800-616-TEAM
801-539-1451 (fax)
http://www.nes1.org
e-mail: info@nef1.org (can send orders via e-mail)

Grades 9-12. $150 (plus 10% shipping and handling). Teachers receive a 20% discount upon request. 1995.

This program teaches advanced energy concepts and how energy technologies related to society connect with the lives of young adults as they are beginning to make the transition from school to work.

Notes: Each section is very thorough and can easily be integrated into existing curricula. Some sections contain lessons that can be brought into all grades 9-12. Good infusion of economics. Teacher introduction coordinates lessons to California state frameworks. It is ideal for an interdisciplinary, project-based curriculum. This material has the potential to spark interest in a wide range of students with various learning styles and academic goals. Open-ended activities allow for student decision making practice.

ENERGY FUN PROGRAM

ORDERING INFORMATION AND COST

National Energy Foundation
5225 Wiley Post Way, Suite 170
Salt Lake City, UT 84116
801-539-1406/ 1-800-616-TEAM
801-539-1451 (fax)
http://www.nes1.org
e-mail: info@nef1.org (can send orders via e-mail)

Grades K-3. $80 (plus 10% shipping and handling). Teachers receive a 20% discount upon request. 1995.

This guide’s thirty-one activities, puzzles, games, and posters support state core curriculum requirements and offer basic energy use concepts to capture the attention of young students.

Notes: Good introduction to the overall concept of energy for primary students. Broad range of lessons incorporating many energy concepts. Lessons are easy to follow. Extensive energy glossary. Lessons are appropriate for grades 2-3. Teachers can earn college credit for completing projects related to the curriculum with their students. Good teacher background on different energy resources. Lessons are basically well organized.

ENERGY FUNDAMENTALS

National Energy Foundation
5225 Wiley Post Way, Suite 170
Salt Lake City, UT 84116
801-539-1406/ 1-800-616-TEAM
801-539-1451 (fax)
http://www.nes1.org
e-mail: info@nef1.org (can send orders via e-mail)

Grades 4-6. $80 (plus 10% shipping and handling). Teachers receive a 20% discount upon request. 1995.

This guide's thirty-one hands-on activities, games, and puzzles support state core curriculum requirements and offer basic fundamental energy and natural resource concepts to capture the attention of young students.

Notes: The book begins with a clear, four page conceptual framework which clearly outlines the seven strands in the material. Twenty pages of in-depth text explain energy basics for the teacher. The posters are quite usable as a teaching tool. The student lab activity and work pages are great, containing clearly drawn and labeled diagrams that present energy concepts in a variety of interesting ways. This curriculum focuses on use of energy and natural resources as well as energy management and awareness.

ENERGY SKILL BUILDERS (several titles): ***Electricity From Water, Wind, and Sunlight*** (5-7); ***Is Efficiency Our Best Energy Source?*** (9-11); ***Paths for Electricity*** (3-5); ***Sources of Electricity*** (4-6); ***The Treehouse Team Saves the Forest*** (2-3); and ***Using Our Resources Wisely*** (4-6)

Enterprise for Education
1316 Third St., Suite 103
Santa Monica, CA 90401
310-394-9864
310-394-3539 (fax)
e-mail: entfored@aol.com

Sources of Electricity is available on the internet at:
www.sourcesofelectricity.com
Free copies of any/all booklets may be available from your local electric utility company. Booklets including student activities and information can be ordered from Enterprise for Education for $1.00 each, teacher guides for $1.90 each.

Notes: Good mini units to supplement an energy curriculum. Hands-on activities for all grade levels. High quality student materials. Pictures and text are interesting. Some activity ideas are included. Could supplement other units. Each unit is a different length and presentation.

GLOBAL WARMING AND THE GREENHOUSE EFFECT

GEMS
Lawrence Hall of Science
University of California
Berkeley, CA 94720-5200
510-642-7771
510-643-0309 (fax)
http://www.lhs.berkeley.edu

Grades 7-10. $16 (does not include tax or shipping and handling); 174 pages.

This guide is designed to help teachers communicate the basics about global warming and the greenhouse effect to students through laboratory activities, simulations, and discussions.

Notes: Great, inexpensive activities to emphasize the chemistry and physics of global warming. Well laid out and organized. Comprehensive on the topic. Illustrates the concept well. Includes a great literature list. Ends with a mock international conference to discuss global warming issues.

GREEN SCHOOLS ENERGY PROJECT

Youth For Environmental Sanity
706 Frederick St.,
Santa Cruz, CA 95062
408-662-0793
408-662-0797 (fax)
e-mail: yes@cruzio.com
http://www.yesworld.org

Grades 7-12. $5.00 for Green Schools Manual. 28 pages,1994. Call to set up assembly performances. Organization also holds summer camps for ages 15-25 in New Hampshire, Oklahoma, Montana, California, Oregon, and Washington. This book contains a step-by-step guide for implementing an energy-saving project in a school district, and supplemental fact sheets on related energy topics.

Notes: Very practical guide to saving energy at school. Steps are easily followed. Good school-wide service project. This guide offers an overview of the procedure to perform an audit and change how the school uses energy. Forms for the audit were presented well. Offers good ideas for doing school projects.

MOUSE HOUSE SURPRISE

Enterprise for Education
1316 3rd St., Suite 103
Santa Monica, CA 90401
310-394-9864
310-394-3539 (fax)
e-mail: entfored@aol.com

Grades K-2. Oversized book $8.25 each, small book $1.00 each; 32 pages, 1993.

This “big book” story and accompanying student booklet introduces students to electricity, appliances that use electricity, and basic electrical safety.

Notes: The text is simple enough for most students to read. Students get their own book to read and write in. Attractive “big book” presentation for introduction to the word “electricity,” including where it comes from and its uses. Grade level appropriate activities. Good safety information for young children. As a piece of a theme it would be helpful. Nondogmatic way to get concepts across.

NATIONAL ENERGY EDUCATION DEVELOPMENT PROJECT (several titles): ***A Current Energy Affair*** (7-12), ***Blueprint for Success*** (4-12), ***Elementary/Middle School Energy Fact Sheets*** (4-8), ***Energy Around the World*** (5-9), ***Energy Enigma*** (7-12), ***Energy Jeopardy*** (5-12), ***Secondary Energy Fact Sheets*** (7-12), ***The Great Energy Debate Game*** (5-12), ***The Museum of Solid Waste and Energy*** (5-12), ***The Science of Energy*** (7-12), ***The Science of Energy Elementary Version*** (5-8), ***Transparent Energy*** (7-12), ***Project Activities*** (4-12), and ***Yesterday in Energy*** (5-9).

Also fact sheets, project activities, and an “energy carnival” (including games and projects) for primary grades.

The National Energy Educational Development Project
P.O. Box 2518
Raston, VI 22090
703-860-5029
703-471-6306 (fax)
www.energyconnect.com\need

Grades 4-12. $35 per year to join (includes membership fee plus 6 free items from the catalogue, subscription to biannual magazine, and eligibility for awards). All materials, conferences, and memberships are available free to teachers in Long Beach Unified School District (California), Kern County (California), and Ventura County (California).

These modules can be used to create an energy education program for one or several grade levels.

Notes: Interesting ideas for hands-on centers. Packets are set up by topic and grade level so the teacher can customize the program. Large number of pamphlets to manipulate (48 in the complete series). Would take a lot of teacher preparation time sorting through the guides and learning an order and approach to teaching this. These activities are designed to develop student’s science, math, language arts, and social studies skills and knowledge while emphasizing energy. Activities look creative, fun, and engaging.

RENEWABLE ENERGY FACT SHEETS

Solar Energy Industries Association
777 N. Capitol St. NE, Suite 805
Washington, DC 20002
202-383-2600
202-383-2670 (fax)
http://www.seia.org

$5 per copy plus $2.50 shipping and handling. 30 pages.

This collection of fact sheets and student activities were developed by renewable energy experts. The material can be photocopied for classroom use.

Notes: Designed for teacher use; reading level is difficult for most high school students. Assumes much prior knowledge. Gives good background information on sources of renewable energy. One activity per energy source is presented to emphasize the information.

SCIENCE PROJECTS IN RENEWABLE ENERGY AND ENERGY EFFICIENCY

National Energy Foundation
5225 Wiley Post Way, Suite 170
Salt Lake City, UT 84116
801-539-1406/ 1-800-616-TEAM
801-539-1451 (fax)
http://www.nes1.org
e-mail: info@nef1.org (can send orders via e-mail)

Grades K-12. $10 each plus shipping and handling. Teachers receive a 20% discount upon request. 139 pages, 1991.

This book focuses on experimental projects that emphasize the scientific method.

Notes: Excellent supplement. Good source for teachers who are new to science projects. Useful in putting together a science fair—provides students with some ideas. Good background information for teachers and high school students. Probably the usefulness of this book increases with the age of the student. List of supplementary materials has been provided to assist teachers. The ideas for projects are creative and somewhat open ended.

SCIENCE, SOCIETY, AND AMERICA'S NUCLEAR WASTE (two titles): **THE NUCLEAR WASTE POLICY ACT AND THE WASTE MANAGEMENT SYSTEM**

Office of Civilian Radioactive Waste Management (OCRWM)
Information Center
Attn: Curriculum Department
4101B Meadows Lane
Las Vegas, NV 89107
1-800-225-6972
http://www.ymp.gov

Grades 10-12. Free. 1995.
These units are part of a four-unit secondary curriculum addressing scientific and societal issues related to the management of spent nuclear fuel.

Notes: Good lessons using statistical analyses. Some good background information for teachers. Some very dry writing. Students would need background in geology, graphing, mapping, geography, and waste management for this to be meaningful. Earth science teachers would like the lab activities. Integrated science. Good map activities. No environmentalists or anti-nuclear folks are in the list of stakeholders.

UNDERSTANDING ELECTRICITY KIT

National Energy Foundation
5225 Wiley Post Way, Suite 170
Salt Lake City, UT 84116
801-539-1406/ 1-800-616-TEAM
801-539-1451 (fax)
http://www.nes1.org
e-mail: info@nef1.org (can send orders via e-mail)

Grades K-6. $10 plus $3 shipping and handling (10% shipping and handling for orders of $30 or more). Teachers receive a 20% discount upon request. 1989.

A collection of ten lesson plans presented without structure for teachers to supplement instruction as they find appropriate.

Notes: Several primary activities on energy that are grade level appro-priate. Nice poster of how energy serves communities. Seems to be a gap between easier and harder concepts. Explains electricity for novices. Lessons can be integrated into current curriculum. Easy to use.

Environmental Education Curriculum and Compendium Project Overview

During the last twenty years, a vast number of environmental education materials have been developed in the United States for the K-12 classroom. Produced by a variety of individuals, agencies, and institutions, these curricula are of varying quality and value to the classroom teacher. Selecting and implementing suitable curricula is, at best, a demanding, complex, and challenging process. To facilitate and encourage the implementation of high quality curricula, the Office of Environmental Education within the California Department of Education (CDE) instituted the Curricula and Compendia project. A project advisory group, made up of representatives from a number of state agencies and offices, established the following project tasks: (1) collect curricula through nation-wide searches; (2) evaluate the quality of curricula using an appropriate assessment instrument; (3) publish the results of the evaluations in topic-specific compendia that use a descriptive, ranking format; and (4) develop and implement strategies for distribution of the publications to educators across California.

To make this curricula review manageable, seven topic areas were logically delineated: Energy Resources, Water Resources, Integrated Waste Management, Air Quality, Human Communities, Plant and Animal Communities, and Terrestrial and Aquatic Habitats (the latter two were later combined to form Natural Communities). The ***Energy Resources*** and ***Water Resources*** compendia were published in 1992 and the ***Integrated Waste*** compendium was published in 1993. The ***Air Quality*** and ***Human Communities*** compendia were published in 1994 and the ***Natural Communities*** compendium was published in 1995. The ***Energy Resources*** and ***Water Resources*** compendia have both been completely redone in 1996.

The evaluation phase of the Curricula and Compendia Project utilizes four strategies: (1) development of a "Unifying Concepts of Environmental Education" matrix by the CDE to serve as a cornerstone linking the project's six topics; (2) formation of an advisory group of experts for each project to create a topical "Conceptual Matrix" that aligns to the Unifying Concepts; (3) elaboration of topic-specific curricula evaluation questions that are directly correlated to the Conceptual Matrix; and (4) systematic evaluation and ranking of environmental education curricula. When considered together, the conceptual matrices for the six compendia provide an extensive yet cohesive foundation upon which curriculum writers, environmental educators, and school administrators can base further instructional materials development in environmental education.

Conceptual Matrices for Environmental Education

Both the "Unifying Concepts of Environmental Education" and the "Conceptual Matrix for Energy Resources" illustrated on the following pages are based upon the CDE environmental education philosophy described in the "Point of View on Environmental Education" (1990). The "Unifying Concepts of Environmental Education" serve to provide a conceptual foundation for defining the boundaries of all environmental education. On the "X" axis are found three content descriptors: The Natural Environment, The Built Environment, and The Personal Environment. On the "Y" axis are three process skills that encompass the full range of cognitive and affective change: Fostering Awareness, Understanding Concepts, and Taking Action.

In the conceptual matrix for this compendium the nine core concepts identified define the boundaries of, and expectations for, energy resources curricula.

Because environmental education is an interdisciplinary subject, the basic concepts of energy resources correspond, to some degree, to almost all the frameworks for California public schools and reflect the underlying philosophy of the California Education Code. Framework correlation have been documented on page XXX.

Unifying Concepts of Environmental Education

Content / Process	**THE NATURAL ENVIRONMENT:** Natural Systems and Interactions	**THE BUILT ENVIRONMENT:** Human Alterations to Natural Environments	**THE PERSONAL ENVIRONMENT:** Citizens' Roles, Responsibilities, Choices, and Actions
Fostering Awareness: Awareness and Respect for the Environment	Individuals are aware that all living things require energy. They can identify the origin and use of standard and alternative energy sourcs.	Individuals differentiate between renewable and non-renewable energy resources. The use of these resources may affect economic productivity, human comfort and the quality of the environment.	Citizens are aware that their quality of life is influenced by energy-related decisions and actions that may be regulated by laws and influenced by local interests, cultural values, political climate and international relations.
Understanding: Understanding Basic Environmental Concepts	Individuals understand that energy resources may be renewable, such as those derived from water, the sun and the wind, or they may be non-renewable, as found in fossil fuels.	Individuals understand the relationship between energy development, production, distribution, and use with respect to long- and short-term environmental, socioeconomic and cultural consequences.	People generate demands for specific types of energy through their expectations for energy-dependent goods and services, their lifestyle choices and their presonal use of energy.
Responsible Actions: Taking Responsible Action Toward the Environment	Individuals make informed choices and take appropriate action to ensure the availability of future supplies of renewable and non-renewable energy resources. They use energy efficiently to minimize their effect on the environment.	Individuals use energy-efficient methods land innovative technologies to conserve non-renewable resources and minimize the impact of energy development, production, distribution and use on human health and the environment.	Informed citizens apply a personal energy ethic to every aspect of their lives. Their ethic is expressed through efficient energy use, compliance with regulations and support for conservation and protection of energy resources. Energy related decisions include analysis of the const/benefit trade-offs and long-term effects on the natural and built environments.

Conceptual Matrix Framework Correlations

Content / Process	FOSTERING AWARENESS AND RESPECT FOR THE ENVIRONMENT	UNDERSTANDING BASIC ENVIRONMENTAL CONCEPTS	TAKING RESPONSIBLE ACTION TOWARD THE ENVIRONMENT
THE NATURAL ENVIRONMENT: Natural Systems and Interactions	**Science:** Physical Science; Earth Science, Life Science. **Physical Education:** Social Development and Interaction. **Visual and Performing Arts:** Aesthetic Perception; Aesthetic Valuing. **History/Social Science:** Knowledge and Cultural Understanding; Skills Attainment and Social Participation; Democratic Understanding and Civic Values.	**Science:** Physical Science; Earth Science, Life Science. **Visual and Performing Arts:** Aesthetic Perception; Aesthetic Valuing. **Health:** Consumer and Community Health; Environmental Health. **History/Social Science:** Knowledge and Cultural Understanding; Skills Attainment and Social Participation. **English/Language Arts:** The Art of Questioning. **Mathematics:** Mathematical Thinking; Mathematical Tools and Techniques.	**Science:** Physical Science; Earth Science. **Physical Education:** Social Development and Interaction; Individual Excellence. **Visual and Performing Arts:** Aesthetic Perception; Aesthetic Valuing. **Health:** Consumer and Community Health; Environmental Health, Individual Growth and Development. **History/Social Science:** Knowledge and Cultural Understanding; Skills Attainment and Social Participation; Democratic Understanding and Civic Values. **English/Language Arts:** The Art of Questioning. **Mathematics:** Mathematical Thinking; Mathematical Tools and Techniques.
THE BUILT ENVIRONMENT: Human Alterations to Natural Systems	**Science:** Physical Science; Earth Science, Life Science. **Physical Education:** Social Development and Interaction. **Visual and Performing Arts:** Aesthetic Perception. **Health:** Environmental Health. **History/Social Science:** Knowledge and Cultural Understanding; Skills Attainment and Social Participation. **English/Language Arts:** The Art of Questioning. **Mathematics:** Mathematical Thinking; Mathematical Tools and Techniques.	**Science:** Physical Science; Earth Science, Life Science. **Physical Education:** Social Development and Interaction. **Visual and Performing Arts:** Aesthetic Perception. Health: Consumer and Community Health; Environmental Health. **History/Social Science:** Knowledge and Cultural Understanding; Skills Attainment and Social Participation. **English/Language Arts:** The Art of Questioning. **Mathematics:** Mathematical Thinking; Mathematical Tools and Techniques.	**Science:** Physical Science; Earth Science, Life Science. **Physical Education:** Individual Excellence. **Visual and Performing Arts:** Aesthetic Perception; Creative Expression; Aesthetic Valuing. **Health:** Consumer and Community Health; Environmental Health, Individual Growth and Development. **History/Social Science:** Skills Attainment and Social Participation. **English/Language Arts:** The Art of Questioning. **Mathematics:** Mathematical Thinking; Mathematical Tools and Techniques.
THE PERSONAL ENVIRONMENT: Citizens' Roles, Responsibilities, Choices, and Actions	**Science:** Physical Science; Earth Science. **Visual and Performing Arts:** Aesthetic Perception; Aesthetic Valuing. **Health:** Consumer and Community Health; Environmental Health. **History/Social Science:** Knowledge and Cultural Understanding; Skills Attainment and Social Participation; Democratic Understanding and Civic Values. **English/Language Arts:** The Art of Questioning.	**Science:** Physical Science. **Physical Education:** Social Development and Interaction. **Visual and Performing Arts:** Aesthetic Perception; Aesthetic Valuing. **Health:** Environmental Health. **History/Social Science:** Knowledge and Cultural Understanding; Skills Attainment and Social Participation; Democratic Understanding and Civic Values. **Mathematics:** Mathematical Thinking; Mathematical Tools and Techniques.	**Science:** Physical Science; Earth Science, Life Science. **Physical Education:** Individual Excellence. **Visual and Performing Arts:** Aesthetic Perception; Creative Expression; Aesthetic Valuing. **Health:** Consumer and Community Health; Environmental Health, Individual Growth and Development. **History/Social Science:** Knowledge and Cultural Understanding; Skills Attainment and Social Participation; Democratic Understanding and Civic Values. **English/Language Arts:** The Art of Questioning. **Mathematics:** Mathematical Thinking; Mathematical Tools and Techniques.

Energy Resources Evaluation Tool

The environmental education evaluation tool used to evaluate the Energy Resources curricula is based on the recommendations and perspectives of the compendia's advisory committee as well as the following documents:

1992 Science Instructional Materials Evaluation Form, California Department of Education, 1992.

Andrews, Bill, *Background Paper I: Environmental Education Strategy of the California Department of Education*, California Department of Education.

Energy Education Evaluation Form - the evaluation tool used for the Water Resources and Energy Resources compendia published in 1992.

Gardella, Ron, *Environmental Education Curriculum Inventory* (Forms A and B), Northern Kentucky University, Highland Heights, KY, 1992.

Health Framework for California Public Schools (pp. 184-195), California Department of Education, 1994.

History-Social Science Framework for California Public Schools (pp. 114-120), California Department of Education, 1988.

Niedermeyer, Fred, *A Checklist for Reviewing Environmental Education Programs* (pp. 46-50), Journal of Environmental Education, Vol. 23, 1992.

Olson, Betsy, *Environmental Education Instructional Materials Evaluation Form*, California Department of Education (draft).

Science Framework for California Public Schools (Chapter 8, pp. 198-213), California Department of Education, 1990.

Science Resource Center, *Rating System for ME-2*, Los Angeles Unified School District.

The Superintendent's Point of View on Environmental Education, California Department of Education 1990.

UNESCO, *The Belgrade Charter*, UNESCO-UNEP Environmental Education Newsletter, Volume 1, Number 1, January, 1976.

UNESCO, *The Tbisili Declaration*, October 1977.

I. Criteria for Instructional Materials

A. General Content

1. Are ideas expressed through unifying themes and big ideas, not facts?

2. Is content interdisciplinary?

3. Are students challenged to utilize higher level thinking processes (i.e., inferring, relating, and applying)?

4. Are ideas presented logically and connected through the curriculum?

5. Is depth of understanding emphasized (rather than encyclopedic breadth)?

6. Are historical, ethical, cultural, geographic, economic, and sociopolitical relationships addressed?

7. Are knowledge and learning shown as connected to students' lives and society?

B. Presentation

1. Are instructional materials clearly and engagingly written with the main concepts well articulated?

2. Are the roles of environmental ethics, citizenship, and stewardship explored?

3. Do lessons promote respect and caring for the environment, yet are nondogmatic and open to inquiry and differences of opinion?

4. Are personal and societal values and conflicting points of view explored in context?

5. Are instructional materials easy for students to use and understand?

6. Is learning made accessible to LEP students?

7. Are writing and concepts developmentally appropriate for the designated grade, yet sensitive to individual differences in educational experience and learning mode?

8. Is environmental responsibility modeled in design, underlying philosophy, and suggested activities by the lessons and materials (e.g., using recycled materials and properly disposing of wastes)?

9. Are there clear linkages presented between communities of all levels? ("thinking globally, acting locally.")

10. Are vocabulary words defined in context and not dominating of learning goals?

11. Is the layout of instructional materials interesting and appealing?

C. Pedagogy

1. Does at least half the curriculum have students engaged in active learning?

2. Is learning based on students constructing knowledge through research, discussion, and application to gain conceptual understanding?

3. Are evaluation devices included and appropriate? (Highest points for authentic, performance based assessment devices.)

4. Are instructional materials sensitive to social, economic, and cultural diversity?

5. Do lessons encourage students to develop awareness, knowledge, and strategies for responsible action?

6. Are group/cooperative learning strategies used?

7. Is intergenerational responsibility, linking today's actions with future consequences, implicit in instruction?

D. Teacher Usability

1. Are instructions for the teacher clear and concise?

2. Are lesson objectives/outcomes clear and appropriate?

3. Are materials easily integrated into an established curriculum?

4. Is background information for the teacher adequate and accurate?

5. Can the materials be adapted to varied learning environments (large/small classes, of mixed levels, from rural/urban settings.)?

6. Are consumable instructional materials of good quality, easily duplicated for student use, and in sufficient quantity to support the objectives?

7. Are equipment/materials listed and reasonably accessible?

8. Are a variety of instructional strategies, expanded learning environments, and resources suggested in the curriculum's design?

9. Is the time required to complete each lesson indicated?

10. Do the materials clearly list the subject discipline(s) integrated into each lesson?

E. Energy Resources Content Questions

Do the materials provide opportunities for students to:

1. Appreciate that energy is essential for all living things?

2. Understand the differences between renewable and nonrenewable energy resources?

3. Practice taking appropriate action to limit the environmental impacts of energy development, production, distribution, and use through energy conservation?

4. Relate human comfort, economic productivity, and environmental quality to energy use?

5. Understand new energy-efficient technologies and their expected impact on future energy supplies?

6. Consider and analyze the environmental, socioeconomic, and cultural consequences of human energy utilization?

7. Explore some of the impact of today's energy choices on future energy availability?

8. Appreciate that today's energy choices and society's actions will impact the future quality of life?

9. Understand energy conservation methods that promote sustainable levels of energy use?

10. Develop a personal energy ethic that enables informed and responsible decision making and action taking?

II. Narrative/Miscellaneous Questions

In thinking back on the materials you've just evaluated:

1. Briefly comment on the strengths of the materials.

2. Briefly comment on the weaknesses of the materials.

3. Put a check mark next to the specific energy resource issues that the evaluated material addressed:

   solar
   conventional (fossil fuel burning)
   hydroelectric
   cogeneration
   wind
   nuclear
   ocean tide
   biomass conversion
   geothermal
   environmental damage
   waste production
   waste storage
   sustainable energy use
   other (what?)

4. Other comments.

5. When considering today's energy issues, are the materials so site specific that they cannot be adapted to the needs of California's classroom teachers? If so, why not?

6. Besides English, in what other languages are the materials available? If not entirely translated, what parts?

7. Do the materials contain a listing of resources, such as in an appendix or teacher resource guide?

8. In the table below, place a check mark in the appropriate box across from each discipline to indicate the amount of emphasis each is given in the curriculum.

EMPHASIS	NONE	SOME	A LOT	MAJOR
DISCIPLINE				
Science				
History/Social Studies				
Health				
Mathematics				
fine/Performing Arts				
Language Arts				
Industrial				
Tech/Voc. Ed.				
Foreign Language				
Other (specify)				